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WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY. VOLUME VII. --ETC(U)
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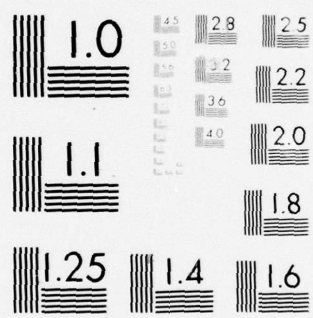

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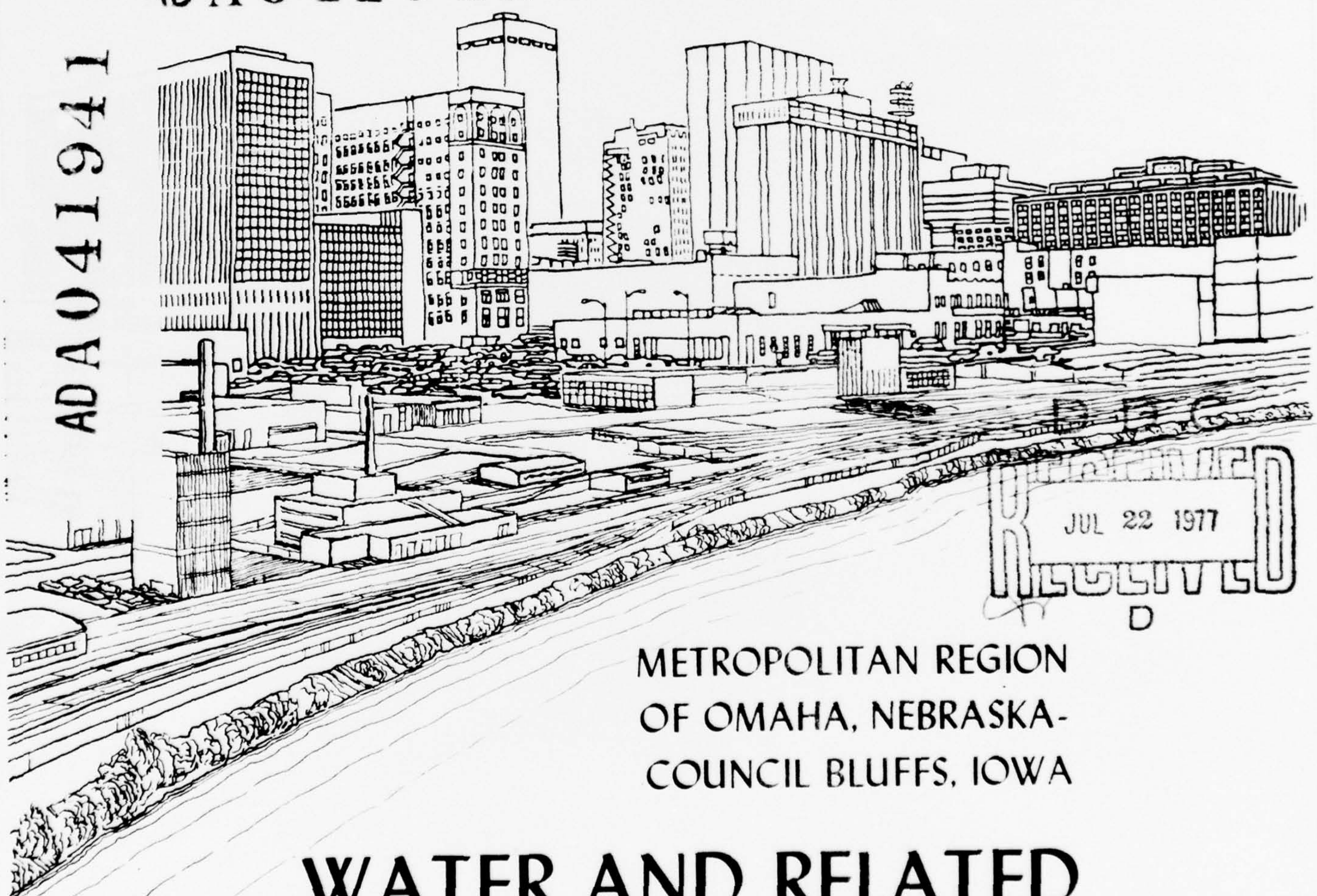
VOLUME VII

EFFECT ASSESSMENT APPENDIX

REVIEW REPORT ON THE MISSOURI RIVER AND TRIBUTARIES



METROPOLITAN REGION
OF OMAHA, NEBRASKA-
COUNCIL BLUFFS, IOWA

WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY

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REVIEW REPORT FOR

Metropolitan

Omaha, Nebraska-

Council Bluffs, Iowa

(11) Jun 75

(12) 266 p.

(6) # WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY.

Volume VII. Effect Assessment Appendix.

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REVIEW REPORT FOR METROPOLITAN OMAHA, NEBRASKA COUNCIL BLUFFS, IOWA WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY

Vol. VII Effect Assessment

SECTION A	INTRODUCTION
SECTION B	ASSESSMENT AND EVALUATION OF INITIAL ALTERNATIVES
SECTION C	ASSESSMENT AND EVALUATION OF FINAL ALTERNATIVES

PREPARED BY THE
OMAHA DISTRICT CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

SECTION A

INTRODUCTION

INTRODUCTION

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SECTION A

INTRODUCTION

Purpose of Effect Assessment and Evaluation

1. Effect assessment and evaluation provides information to the planning process that will aid in the acceptance, reformulation, or rejection of alternative plans.

2. The purpose of effect, or impact assessment is to identify and measure the economic, social, and environmental changes from the base conditions that are expected to result from alternative plans.

3. The purpose of evaluation is to determine how well the alternative plans achieve the planning objectives and how the plans affect other related problems. Evaluation requires public values to measure the relative significance of the impacts.

→ next page

cont.

4. The net result of impact assessment and evaluation should be the presentation of information in sufficient detail to permit the selection by decision makers of alternatives that contribute the most to local, regional, and national objectives and at the same time, minimize adverse actions in any area.

Methodology

5. The planning process consists of three iterations of problem identification, formulation of alternatives, effect assessment, and evaluation. The first iteration results in development of the Plan of Study. The second iteration develops initial plans; and the third iteration develops the final plans.

6. The efforts given to impact assessment and evaluation increase as the planning process proceeds to development of the final plans. In the first iteration, very general assessments are used to determine the problems to be studied. In the second iteration, assessments are performed only to the level of detail to determine the best alternatives to carry forward to the third iteration. In the majority of cases, economic and technical feasibility are the primary factors in the second iteration assessments.

7. The third iteration of the planning process emphasizes effect assessment and evaluation. The output of the third iteration is the selection of the final plans and the labeling of the NED (national economic development) and the EQ (environmental quality) plans.

8. The methodology for performing the effect assessment and evaluation is described in the Water Resource Council's Principles and Standards for Planning Water and Related Land Resources (P&S). The P&S also established a system of accounts to display beneficial and adverse effects of each plan in the planning objectives and on regional development and social well-being. This system of accounts was used to display the results of the effect assessment and evaluation of the final plans.

9. Omaha District staff, particularly the Economic and Social Analysis Branch and the Environmental and Master Planning Branch, performed the majority of the effect assessment and evaluation for plans developed by the consultants and by in-house forces. The consultant's reports provided some of the data required for the impact assessment, particularly in the area of water quality impacts.

10. The U. S. Fish and Wildlife Service also contributed to the impact assessment and evaluation efforts by reviewing and commenting on the alternative plans.

11. All alternatives, with the exception of flood control and recreation on the Papillion Creek System, were evaluated using a 7-percent discount rate to be relatively consistent with the Water Resources Council's original discount rate of 6-7/8 percent for Fiscal Year 1974 and the Environmental Protection Agency's (EPA) 7-percent rate for areawide wastewater management planning.

12. Flood control and recreation for Papillion Creek were evaluated using the project's authorized discount rate of 3.25 percent. Flood control for Indian Creek was evaluated using the current Federal discount rate of 6.125 percent. All other flood control

alternatives were evaluated using the 5.875 percent discount rate specified for Fiscal Year 1975 by the Water Resources Council.

13. EPA guidelines were used to determine elements of costs, service life, and salvage value for the wastewater management systems.

14. In formulating and evaluating the flood control alternatives, it was assumed that flood plain zoning will be implemented in accordance with the Flood Disaster Protection Act of 1973 (Public Law 93-234). No future development within the 100-year flood plain was considered.

15. The NED accounts for most of the plans contain a benefit for the use of unemployed labor during construction. EC-1105-2-42 dated 28 November 1975 disallows use of this benefit unless the region is classified as one of substantial or persistent unemployment by the Water Resources Council. Since the Omaha-Council Bluffs area has not been designated as such an area, revisions to the Urban Study should exclude this benefit. However, the benefits used in the study are not significant enough to affect plan consideration or selection.

16. The majority of the plans evaluated in this appendix are presented in terms of present worth costs. Most of the plans, particularly for wastewater management and water supply, consist of time phasing of capital and operation and maintenance expenditures. The Annexes under Volume V-Supporting Technical Reports Appendix should be consulted for details regarding capital and operation and maintenance expenditures.

SECTION B

ASSESSMENT AND EVALUATION OF INITIAL ALTERNATIVES

ASSESSMENT AND EVALUATION OF INITIAL ALTERNATIVES

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ASSESSMENT AND EVALUATION OF INITIAL ALTERNATIVES

Land Use and Urban Growth

1. The urban study employed alternative futures in the planning process. The use of alternative futures was necessitated by the lack of an existing land use plan in which local planners and the public expressed confidence. The alternative futures were expressed in terms of alternative land use patterns.

2. Initially, eight alternative futures were considered. These eight were:

- No growth
- Unplanned peripheral sprawl development
- Redevelopment of older neighborhoods

- Satellite new cities within commuting range of the metropolitan area

- Planned peripheral growth

- Stellar growth along major transportation corridors

- New cities beyond commuting range of the metropolitan area

- Expanded non-metropolitan communities beyond the commuting range of the metropolitan area

3. No urban growth was eliminated from further consideration. Actual zero population cannot be achieved within the next 50 years. Omaha's current growth rate is above the State and national rates. The relative abundance of water resources and the central location of the study area tend to make the area attractive for growth. A recent news article, based on a national study, indicated that Omaha will increase it's population ranking from 48th to 31st in the Nation from 1970 to 1980.

4. Unplanned peripheral sprawl development was retained as a trends forecast. This alternative was defined as the most probable alternative in a report prepared for the urban study by Dana College entitled "Socio-Economic Impact on Changing Life Styles to the Year 2020". It is also contended to be the "publicly preferred" growth concept by people familiar with real estate.

5. Redevelopment of older neighborhoods was retained as part of a final alternative. Nationally and locally, there has been concern with the decay of the urban core and the flight to the suburbs. The major local endeavor to implement this alternative

is the Riverfront Development Program (RDP) of the Metropolitan Area Planning Agency. The RDP is explained in detail in Volume V-Annex H of this report.

6. Satellite new cities within commuting range of the metropolitan area was retained as a limited part of a final alternative. This concept was initiated by the New Towns Study of the Riverfront Development Program. Two of the more feasible satellite new towns were included in a final alternative for the urban study. The public is concerned with the overall costs and the provision of services to these new towns.

7. Satellite cities built upon existing small communities within commuting range of the metropolitan area were retained as a major part of a final alternative. This concept has received strong public support, particularly from officials in the small communities. This concept calls for economic growth of the communities while maintaining local independence from the metropolitan area.

8. Planned peripheral growth is a concept included in all of the final alternatives for the urban study. The concept is supported by the majority of the public, and by some of the developmental interests. The urban study analyzes alternative population densities within the planned peripheral growth areas.

9. Stellar growth along transportation corridors was the basis for one of the final urban study alternatives. Several local planners felt that growth could occur in this manner.

10. New cities beyond the commuting range of the metropolitan area were rejected due to the lack of economic development potential, lack of existing governmental system, and public non-acceptance.

11. Expanded non-metropolitan communities beyond the commuting range of the metropolitan area were included in the final alternatives. State or local projections were used to establish future population levels.

12. From the impact assessment and evaluation of the above concepts, four alternative urban growth patterns were selected for use in the urban study. The four growth patterns are:

- Concept A - Spread growth pattern, basically the trends forecast of low-density spread development. This alternative is consistent with existing land use plans.

- Concept B - Satellite city pattern coupled with redevelopment of the older neighborhoods, moderate high-density planned growth in the urban periphery, and fill-in of vacant areas within the city.

- Concept C - Compact growth pattern with moderate high-density planned growth on the urban periphery, redevelopment of older neighborhoods, and fill-in of vacant areas within the city.

- Concept D - Stellar type low-density growth patterns along major transportation corridors.

The impacts and evaluation of the four growth patterns will be discussed in the next section. A detailed description of the

four patterns is contained in Volume III-Annex A-Alternative Futures.

Wastewater Management

AREAWIDE PLANS

13. Eight initial areawide wastewater management plans were developed. The areawide plans include alternatives for industrial and domestic wastewater, combined sewer overflows in the Missouri River, Little Papillion Creek, and Indian Creek drainage areas; and separate urban stormwater runoff . Combined overflows in the Missouri River drainage area were also the subject of a separate study and are discussed later. Also considered within the initial areawide plans were alternative treatment levels and alternative design storms, water treatment plant sludge handling, flow reduction, and infiltration/inflow analyses.

14. Table B-1 provides a general description of the eight areawide plans. The treatment technology employed at the major, minor, and nonurban plants is designated either as "Treatment and Discharge" for the conventional treatment plants with direct discharge to the receiving stream or as "Land Treatment System" for secondary effluent application on land systems. The treatment concept employed for the urban stormwater runoff is indicated as "Upsystem Treatment and Discharge" or as "Conveyance". The degree of regionalization is indicated by the number of plants within each of the categories. Overflows in Papillion Creek and Indian

Table B-1
General Description
Regional Wastewater Management Plans

PLAN	BRIEF DESCRIPTION	MUNICIPAL WASTEWATER SYSTEMS			COMBINED SEWER OVERFLOW & URBAN STORMWATER RUNOFF SYSTEMS	
		MAJOR URBAN	MINOR URBAN	NON-URBAN	PAPILLION BASIN	COUNCIL BLUFFS
I	Basic Plan	3 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge
II	Basic Plan with limited extension of Papillion Creek Interceptor System	3 Plants Treatment & Discharge	11 Plants Treatment & Discharge	34 Plants Treatment & Dicharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge
III	Basic Plan with stormwater treatment variation	3 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Conveyance to Papillion Creek Plant for treatment	Conveyance to Mosquito Creek Plant for treatment
IV	Regionalization at Papillion Plant	2 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge
V	Regionalization with stormwater treatment variation	2 Plants Treatment & Discharge	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Conveyance to Papillion Creek Plant for treatment	Conveyance to Mosquito Creek Plant for treatment
VI	Land treatment systems for all wastewater	3 Secondary Plants Transmission to Remote Land Treatment System	7 Secondary Plants Transmission to Local Land Treatment System	34 Secondary Plants Transmission to Local Land Treatment System	Conveyance to Papillion Creek Plant for treatment and Transmission to Remote Land Treatment System	Conveyance to Mosquito Creek Plant for treatment and Transmission to Remote Land Treatment System
VII	Combination of land treatment system and treatment and discharge	3 Plants Treatment & Discharge	11 Secondary Plants Transmission to Local Land Treatment System	34 Secondary Plants Transmission to Local Land Treatment System	Upsystem Treatment and Discharge	Upsystem Treatment and Discharge
VIII	Combination of land treatment system and treatment and discharge	3 Secondary Plants Transmission to Remote Land Treatment System	7 Plants Treatment & Discharge	34 Plants Treatment & Discharge	Upsystem Treatment & Discharge	Upsystem Treatment & Discharge

Creek are provided with either upsystem treatment and discharge or conveyance. Omaha-Missouri River overflows use one of the alternatives discussed later.

15. Plans I and II were designed to test regionalization of the Papillion Creek interceptor sewers. Regionalization of the three major urban treatment plants to two plants by eliminating the Missouri River plant was evaluated by comparing Plan IV with Plan I. Conveyance of stormwater to the municipal treatment plants versus individual upstream treatment plants was evaluated by comparing Plans I and III and Plans IV and V. Land treatment for both wastewater and stormwater was evaluated in Plan VI. Plan VII evaluated land treatment for the minor-urban and rural communities only, and Plan VIII evaluated land treatment for the three major urban plants only. Present worth costs for the eight plans with the three alternative treatment levels and three design storms are given in table B-2.

16. Plans I and II, in addition to evaluating regionalization, correspond to the four growth patterns. These two plans were comparable in costs and were retained for final evaluation.

17. Plan III was rejected as a complete alternative. Stormwater conveyance featured in this plan was found not to be cost effective compared to upsystem treatment, as evidenced by table B-3. In addition, upsystem treatment allows more flexibility for incorporating nonstructural management techniques and was favored by the Interagency Coordinating Committee.

Table B-2
PRESENT WORTH COSTS-REGIONAL WASTEWATER PLANS
($ Million)

Component	Design Storm	Concept A Level 1	Concept A Level 2	Concept A Level 3	Concept B Level 1	Concept B Level 2	Concept B Level 3	Concept C Level 1	Concept C Level 2	Concept C Level 3	Concept D Level 1	Concept D Level 2	Concept D Level 3
(PLAN I)													
	Total 1 Year	584	661	781	600	684	803	563	640	758	580	656	785
	Total 5 Year	829	906	1,109	846	930	1,123	804	881	1,064	827	903	1,103
	Total 10 Year	971	1,048	1,305	973	1,057	1,268	936	1,013	1,215	963	1,039	1,297
(PLAN II)													
	Total 1 Year	585	664	795	603	694	815	562	642	762	581	660	790
	Total 5 Year	833	912	1,115	852	943	1,138	812	887	1,072	830	909	1,110
	Total 10 Year	975	1,054	1,300	979	1,070	1,283	939	1,019	1,223	966	1,045	1,304
(PLAN III)													
	Total 1 Year	670	747	788	666	750	784	625	702	739	665	741	781
	Total 5 Year	847	909	970	821	905	944	794	871	912	832	908	953
	Total 10 Year	986	1,063	1,113	932	1,016	1,057	930	1,007	1,050	948	1,024	1,073
(PLAN IV)													
	Total 1 Year	641	718	836	647	729	839	620	696	801	640	717	833
	Total 5 Year	897	974	1,164	902	984	1,168	870	946	1,116	896	973	1,160
	Total 10 Year	1,039	1,116	1,349	1,029	1,111	1,313	1,002	1,078	1,267	1,032	1,109	1,354
(PLAN V)													
	Total 1 Year	720	797	824	704	786	812	674	750	776	713	790	882
	Total 5 Year	895	972	1,096	860	942	971	848	924	949	830	957	990
	Total 10 Year	1,035	1,112	1,150	972	1,054	1,085	980	1,056	1,088	998	1,075	1,111
(PLAN VI)													
	Total 1 Year	670	1,065	1,077	666	1,038	1,047	625	995	1,004	665	1,074	1,085
	Total 5 Year	847	1,252	1,269	821	1,203	1,217	794	1,174	1,187	832	1,254	1,270
	Total 10 Year	986	1,404	1,425	932	1,319	1,335	930	1,315	1,330	948	1,377	1,397
(PLAN VII)													
	Total 1 Year	497	583	665	412	614	689	473	559	636	486	572	645
	Total 5 Year	679	765	901	693	795	921	649	735	853	676	762	895
	Total 10 Year	780	866	1,016	779	881	1,013	740	826	952	771	857	1,046
(PLAN VIII)													
	Total 1 Year	584	852	962	600	858	961	771	830	927	580	849	955
	Total 5 Year	840	1,108	1,290	855	1,113	1,290	1,021	1,080	1,242	836	1,105	1,282
	Total 10 Year	982	1,250	1,475	982	1,240	1,435	1,153	1,212	1,393	972	1,241	1,476

(national economic development) and the EQ (environmental quality) plans.

A-2

Table B-3
Stormwater Handling
Present Worth Costs
($1,000,000)

Concept	Level 1				Level 2			
	A	B	C	D	A	B	C	D
(1) Upsystem Treatment	178.8	185.4	165.8	173.3	215.8	227.0	195.3	224.9
(2) Conveyance to Municipal Plant	339.7	333.0	307.8	340.7	351.0	342.5	312.6	351.2
Ratio $\frac{(2)}{(1)}$	1.89	1.80	1.86	1.97	1.62	1.50	1.60	1.56

18. Plan IV was rejected as a final alternative. Table B-4 shows a comparison of present worths for separate plants (Missouri River and Papillion Creek) versus combined plants (transporting Missouri River pretreatment effluent to the Papillion Creek Plant). This analysis indicates the separate plant scheme to be slightly less expensive than the combined plant scheme.

Table B-4
Two Plants vs One Plant
Present Worth Costs
($1,000)

Separate Plants	Capital	O&M
Papillion	$32,947	$30,825
Missouri River	39,317	30,360
Total	$72,464	$61,185
Grand Total	$133,649	

Combined Plants	Capital	O&M
Papillion	$72,675	$55,416
Missouri River (Pretreatment)	0	8,994
Total	$72,675	$64,410
Grand Total	$137,085	

19. Stream Modeling of the Missouri River also indicates that the combined plant discharge effect on the water quality of the Missouri River may be more severe than the two plant discharges. Plan V was rejected for the same reasons as Plan IV.

20. Plan VI was rejected from further consideration. A present worth cost comparison of Plan VI with Plans VII and VIII indicated that handling stormwater in land systems is more expensive than separate stormwater treatment. In addition, land application of stormwater would dilute the nutrient concentration of the wastewater and at the same time, add undesirable constituents such as heavy metals and salts to the soil. Separate stormwater treatment also allows more flexibility to implement nonstructural methods to reduce urban runoff pollution.

21. Plan VII was retained as a plan for final evaluation. This plan was the most cost-effective plan for achieving all levels of wastewater treatment.

22. Plan VIII was retained for final evaluation but was renamed as a Land Treatment Option for the major urban treatment plants. This option could be used with any of the final plans. The Land Treatment Option was expanded to consider the impacts of several subalternatives. These subalternatives included alternative land treatment areas, winter discharge to the Missouri River, and alternative application rates. These subalternatives are discussed in the next section.

23. The initial areawide plans considered the same alternatives for combined sewer overflows in the Papillion Creek and Indian Creek (Council Bluffs) basins as were considered for urban runoff. These were either upstream treatment and discharge or conveyance to the Papillion Creek and Mosquito Creek treatment plants. It was decided that alternatives for these two combined sewer areas should be analyzed separately from the areawide plans. In addition, the alternatives were expanded to analyze sewer separation. The impact assessment and evaluation of the alternatives for these two combined sewer areas is discussed in the next section.

24. More details concerning the initial areawide wastewater management plans can be found in Volume V-Annex H.

OMAHA-MISSOURI RIVER COMBINED OVERFLOWS

25. Initially, over 30 alternatives were considered to abate pollution from the Omaha-Missouri River combined sewer overflows.

These 30 alternatives were evaluated for costs, technical feasibility, and relative merits to one another. The 30 initial alternatives were narrowed to 12 alternatives for more detailed analysis. The 12 alternatives and their costs are listed in table B-5. A subjective evaluation of the 12 is contained in table B-6.

26. Alternative 1, buried storage at 15 outfall points was rejected due to costs. The costs are high for this alternative because high ground water conditions would necessitate expensive construction features to overcome buoyancy forces when the tanks are empty.

27. Alternative 2, diked storage along the flood control levee, was retained for further consideration as a moderate cost alternative.

28. Alternative 3, upstream retention, was rejected as a complete system alternative due to disruptive effects. Further analysis indicated that alternative 3 was not cost effective as a partial alternative.

29. Alternative 4A, deep tunnel north to ground level storage north of Council Bluffs, was retained for further consideration as a moderate cost alternative that minimizes esthetic effects.

30. Alternative 4B, excavated storage in the north part of the combined sewer area with a deep tunnel to a storage area south of Council Bluffs, was retained for further consideration. This alternative reduced the costs of alternative 4A by locating storage lagoons in the industrial areas near Carter Lake.

Table B-5
Present Worth Costs - Omaha Missouri River Overflow Alternatives

		System Components						Summary of Costs for Secondary Treatment at 7% Interest Rate				
		Conveyance		Storage		Treatment4/						
		Constr Cost	Annual O&M	Constr Cost	Annual O&M	Constr Cost	Annual O&M	Total of Constr Costs	Land Costs	Total Annual O&M	Present Worth of Annual Costs5/	Total Present Worth
1	Buried Storage at Outfalls	6.1	0.2	517.7	1.7	12.7	1.4	536.5	1.7	3.3	51.3	589.5
2	Diked Storage Along Levee	76.0	1.0	37.5	1.7	12.7	1.4	126.2	6.0	4.1	75.3	207.5
3	Upstream Retention	12.2	0.5	111.9	1.7	12.7	1.4	136.8	12.2	3.6	56.6	205.6
4 A	Deep Tunnel North to Ground Level Storage	128.5	0.3	18.1	1.7	12.7	1.4	159.3	2.2	3.4	53.1	214.6
4 B	Excavated Storage North-Deep tunnel South to Ground Storage	52.3	0.3	36.0	1.7	12.7	1.4	101.0	7.6	3.4	53.0	161.6
5 A	Deep Tunnel With Mined Storage	77.9	0.4	161.4	1.7	12.7	1.4	252.0	1.7	3.5	54.6	308.3
5 B	Excavated Storage North-Deep Tunnel to Mined Storage South	41.6	0.3	120.5	1.7	12.7	1.4	174.8	5.5	3.4	52.9	233.2
6	Flow-Through Treatment With Storage at Outfall	8.4	0.3	336.1	1.1	31.1	3.0	375.6	0.3	17.0	47.3	423.2
7	Sewer Separation1/	539.3	-	-	-	-	-	539.3	-	-	-	539.3
A	In-system Attenuation Devices 2/	-	-	70.2	0.3	12.7	1.4	82.9	1.7	1.7	39.5	123.4
B	Deep Tunnel to the Papillon Creek STP3/	96.0	0.1	110.8	1.9	3/	3/	206.8	-	2.0	29.8	236.6
C	Flow-Through Treatment for "First Flush"	-	-	-	-	278.9	0.3	278.9	2.4	0.3	55.5	336.8

1/ For storms of any recurrence intervals

2/ Capable of reducing number of overflows to several times per year

3/ Does not include treatment - regional concept

4/ Costs for higher levels of treatment can be obtained from Plate [illegible]

5/ Includes costs for replacement

Note: All costs in millions and are for 5-year storm recurrence interval.

Table B-6
Subjective Evaluation
Omaha Missouri River Overflow Alternatives

		Aes-thetic Effects	Disrup-tive Effects	Likelihood of Public Acceptance	Treatment Attain-Ability	Flexi-bility for Staging	Site Avail-ability	Maintenance and Operation	Redundency[1/] Effect	Energy Use
1	Buried Storage at Outfalls	Good	Low	Good	Good	Good	Poor	Poor	Excellent	Good
2	Diked Storage Along Levee	Poor	Moderate	Fair	Good	Fair	Fair	Fair	Excellent	Poor
3.	Up-stream Retention	Poor	High	Poor	Fair	Good	Poor	Poor	Poor	Good
4A	Deep Tunnel north to Ground Level Storage	Fair	Low	Good	Good	Poor	Good	Good	Excellent	Fair
4B	Excavated Storage North-Deep Tunnel South to Ground Storage	Fair	Moderate	Fair	Good	Poor	Good	Fair	Good	Fair
5A	Deep Tunnel with Mined Storage	Good	Low	Excellent	Good	Poor	Good	Good	Excellent	Poor
5B	Excavated Storage North-Deep Tunnel to Mined Storage South	Fair	Moderate	Fair	Good	Poor	Good	Fair	Good	Fair
6	Flow-Through Treatment with Storage at Outfall	Poor	Moderate	Fair	Fair	Good	Fair	Poor	Poor	Good
7	Sewer Separation	Good	High	Poor	Excellent	Good	Good	Good	Poor	Good
A	In-System Attenuation Devices	Good	Moderate	Good	Poor	Good	Good	Poor	Poor	Good
B	Deep Tunnel to the Papillon Creek STP	Good	Low	Good	Excellent	Poor	Good	Good	Excellent	Poor
C	Flow-through Treatment for "First Flush"	Poor	Moderate	Fair	Poor	Good	Fair	Poor	Poor	Good

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1/ Capability of preventing dry-weather overflows resulting from mechanical failure of pumping facility on interceptor system or breakdown of sewage treatment plant

31. Alternative 5A was retained for further consideration. All components of this alternative would be located below ground and would not produce the potential for esthetic problems associated with the other selected alternatives.

32. Alternative 5B was excluded from further consideration mainly because components of this alternative would be analyzed as parts of the retained alternatives. The final analysis indicates that this alternative may be worthy of consideration within future planning activities.

33. Alternative 6 was initially rejected due to costs and lack of performance commensurate with the other alternatives. This alternative was again considered under development of the areawide wastewater plans and is discussed in the next section under new alternative 1.

34. Alternative 7, sewer separation, was rejected due to costs, disruptive effects, and the inability to provide treatment for separate stormwater.

35. Alternative A, in-system attenuation devices, was rejected as a complete alternative because it could not meet the initial planning objectives of providing secondary treatment to the majority of the overflows. It was further considered as a partial alternative but was found not to be cost effective.

36. Alternative B was retained for further consideration to complement areawide Plan IV by eliminating the Missouri River plant and by providing a conveyance mechanism to the new Papillion Creek plant. Since areawide Plan IV was rejected, alternative 3 was also excluded.

37. Alternative C was rejected due to costs and the inability to perform as well as the other alternatives. The concept of this alternative is considered under new alternative 1.

38. A detailed description of the 12 alternatives and the reasons for rejection or retention are contained in Volume V - Annex J.

ALTERNATIVE TREATMENT LEVELS AND DESIGN STORMS

39. Three alternative treatment levels were considered for wastewater sources, and two were considered for stormwater and combined sewer overflows. The 1-, 5-, and 10-year storm recurrence intervals for urban storm runoff and combined sewer overflows were considered in initial facility sizing and costing.

40. The three alternative treatment levels for wastewater were carried into the final alternatives to determine the costs and effects of secondary treatment, best practicable waste treatment technology, and zero discharge. The two alternative stormwater treatment levels were also carried forward to provide stormwater and combined overflow treatment relatively commensurate with the wastewater levels. Level 1 stormwater treatment was used with Level 1 and Level 2 wastewater treatment; Level 2 stormwater treatment was used with Level 3 wastewater treatment. The effects of the alternative treatment levels are discussed throughout the next section.

41. Of the three design storm recurrence intervals analyzed, the 1-year storm appears to be the most cost-effective design storm. This conclusion is, however, based only on an analysis of dissolved

oxygen impacts. The treatment methods employed would also reduce other constituent impacts although the reductions have not been determined.

42. The preliminary conclusion to use a 1-year design storm for the final alternatives was based on the following analyses.

Water quality modeling conducted for both the Missouri River and Papillion Creek indicates noncontravention of State water quality standards with retention of the 1-year storm. (Valid for dissolved oxygen only.)

A comparison of table B-2 and table B-7 indicates that providing additional treatment capability is more cost effective than increasing the design storm capacity.

Alternatives designed for the 1-year storm would capture the first flush of most storm occurrences and would capture in excess of 94 percent of the annual runoff.

43. Volume V-Annexes C,H, and J provide more thorough discussions of the design storm.

Water Supply

44. Initial planning efforts for water supply included analyses of alternative supply resources, methods of water use reduction, dual water systems, and regionalization. Four initial water supply

Table B-7
Comparison of Annual Pollutant Loads - 1995, Concept A

Parameter	Influent**	Level 1 Treatment 1 yr.*	Level 1 Treatment 5 yr.*	Level 1 Treatment 10 yr.*	Level 2 Treatment 1 yr.*	Level 2 Treatment 5 yr.*	Level 2 Treatment 10 yr.*
Suspended Solids							
Stormwater (Tons)	48,626	18,186	15,949	15,463	9,433	6,564	5,932
Reduction (percent)		62.0	67.0	68.0	80.0	86.0	87.0
BOD							
Stormwater (Tons)	4,474	2,872	2,756	2,728	1,790	1,597	1,552
Reduction (percent)		35.0	38.0	39.0	59.0	64.0	65.0
Phosphorus							
Stormwater (Tons)	134	67	62	60	48	41	40
Reduction (percent)		50.0	53.0	55.0	64.0	69.0	70.0
Nitrogen							
Stormwater (Tons)	458	401	396	396	384	378	372
Reduction (percent)		12.0	13.0	13.0	16.0	17.0	18.0

* Stormwater Treatment Facilities are designed for storm of given recurrence interval
** Annual Influent Volumes (MG): Stormwater = 30,343

plans were developed for the study area using the basic assumption that eventually, essentially all residents in the study area will be served by a rural or an urban water system and that treatment of all water sources to the 1962 United States Public Health Service recommendations and to the 1974 Safe Drinking Water Act standards is desirable and beneficial.

ALTERNATIVE SUPPLY RESOURCES

45. Alternative supply resources investigated included surface and ground waters, wastewater recycle, stormwater runoff, and power plant heated discharge.

46. Basically all surface and ground water in the study area can be used as a source of supply. There are economic, reliability, and environmental considerations that distinguish the desirability of a source. These considerations are discussed in the next section.

47. The recycling of sewage treatment plant effluents was investigated as an alternative water supply source. The quality of the effluent would range from secondary treatment (Level 1) to zero pollutant discharge (Level 3). These levels are described in Volume V-Annex H. The abundance of fresh water in the study region has previously precluded serious consideration of wastewater recycle.

48. Recycling of highly treated sewage treatment plant effluents for some uses, such as for cooling water, toilet flushing, and lawn watering, but not for drinking purposes may be both feasible and desirable. The Environmental Protection Agency has issued a policy statement that at the present time, there should be no direct reuse of advanced wastewater treatment effluents for domestic

purposes. Perfection of virus detection techniques and reliability of advanced treatment processes will be required prior to wastewater reuse for domestic consumption.

49. Studies performed in other parts of the country and public contacts in the Omaha-Council Bluffs area indicate some acceptance of wastewater recycle for nonpotable water use. Residential applications would require a dual water system as discussed later in this section. Acceptance of recycled wastewater for cropland irrigation appears to be the rule, rather than the exception, in the study area. This alternative will be discussed in the next section.

50. Power plants use large volumes of water directly from the Missouri River. Boilers need small volumes of extremely high quality water. Food processes need potable-quality water. None of the above would have promising application of recycled wastewater.

51. It is for the above reasons that wastewater recycling, with the exception of agricultural applications, was rejected as a supply source.

52. The use of storm runoff as a source of water supply was investigated. The Wastewater Management Studies indicated that capturing and treating the 1-year storm would be sufficient to protect stream water quality. Treatment would consist of screening, settling, and chlorination with subsequent release to the receiving stream. Although the quality would be suitable for some supply uses, sufficient quantity would not be available particularly during maximum water use periods (dry weather) to significantly affect overall water use and system design.

53. Flood control dams, such as those in the Papio Flood Control Project, offer storm runoff use possibilities. The proposed dams are to be constructed only for flood control, recreation, and water quality. Water supply storage would have to be added to the project purpose in order for the dams to be used for water supply. The water in the reservoirs could be of lower quality than that of available ground waters.

54. The use of storm runoff is also somewhat dependent on dual water systems which will be discussed later.

55. There are two basic considerations for using cooling-water discharge from power plants in lieu of traditional water supply sources: first, if the heat energy itself can be put to beneficial uses; and second, if subsequent use of the water can serve to dissipate the heat and thus prevent possible thermal pollution of the receiving waters.

56. Several possible uses for this source of water were investigated. On a system-wide basis, power plant cooling water could, after proper treatment, be introduced into the existing municipal distribution system. Modifications to the distribution system would be required due to the higher water temperatures. Recycle to the Florence Water Treatment Plant was suggested for intake heating in the winter to reduce icing problems and merits consideration by the Metropolitan Utilities District.

57. Several special-purpose uses were also suggested. Growth rates and yields for certain crops can be increased through elevated soil temperatures. Irrigation with heated water could also provide longer growing seasons and protection against early killing

frosts. Increased water temperature can increase the rate of growth and ultimate size of certain fish and crustaceans. Another use would be for wastewater treatment plants, where the higher temperatures could increase reaction rates and decrease overall treatment costs.

58. All of the above are possible uses of the heated water from power plants, but it is important to remember that over 1,000 mgd of the water is available for use, and that, most likely, thermal pollution of the river would continue since not all of the water could be used.

59. A detailed evaluation of power plant heated discharge was not within the scope of the urban study and was therefore not included in the water supply plans.

60. Use of the above nonpotable water supply sources in dual water systems was considered for toilet flushing, lawn and garden irrigation, street flushing, fire protection, and industrial cooling operations. The dual water system concept is evaluated as initial Water Supply Plan IV.

WATER USE REDUCTION

61. Water use reduction alternatives considered and resultant impacts are summarized in table B-8.

62. Combining all of the reduction concepts could appreciably affect future water demands; however, some of the concepts should receive less emphasis due to several factors as discussed below.

Table B-8

SUMMARY OF WATER
USE REDUCTION CONCEPTS

WATER USE REDUCTION CONCEPTS				% REDUCTION PER APPLICABLE RESIDENTIAL CUSTOMER (DWELLING UNIT)			1995 TOTAL POTABLE SUPPLY REDUCTION		ALTERNATIVE SUPPLY CONCEPTS			SCOPE OF APPLICABILITY		TECHNOLOGY REQUIRED			INVESTMENT TO IMPLEMENT		
				POTABLE WATER SUPPLY REQUIREMENTS	TOTAL WATER SUPPLY REQUIREMENTS	SEWAGE FLOWS	PERCENT	ACTUAL (AVERAGE ANNUAL MGD)	NON-POTABLE SUPPLIES: WELLS, SURFACE WATER, STORM WATER, ETC.	REUSE SUPPLY: WASTEWATER SYSTEM-WIDE	REUSE: WASTEWATER, INTERNAL SYSTEM	TOTAL POPULATION	NEW GROWTH AND LAND DEVELOPMENT	EXISTING	DEVELOPING	NEW	PUBLIC	PRIVATE	PUBLIC ACCEPTABILITY
				%	%	%	%	MGD											
WATER USE REDUCTION CONCEPTS	NON - STRUCTURAL	1	VOLUNTARY ACTION; WATER CONSERVATION ATTITUDES	NA	NA	NA	NA	NA	NA	NA	NA	X		X			MINOR		GOOD
		2	LEGAL ACTIONS	NA	NA	NA	NA	NA	NA	NA	NA	X		X			MINOR		FAIR
		3	INDUSTRIAL DEVELOPMENT PROMOTION	NA	NA	NA	7%	12MGD	NA	NA	NA		X	X			MINOR		GOOD
		4	PRICING POLICIES (50% PRICE INCREASE)	17%	17%	5%	11%	20MGD	NA	NA	NA	X		X			MINOR		FAIR
		5	METERING OF INDIVIDUAL APARTMENT UNITS AND MOBILE HOMES	25%	25%	25%	3%	5MGD	NA	NA	NA	X		X			MODERATE		GOOD
	STRUCTURAL	6	WATER CONSERVING FIXTURES AND APPLIANCES	6 TO 31%	6 TO 31%	7 TO 39%	.8 TO 4.0%	UP TO 7 MGD	NA	NA	NA	X		X	X			MODERATE	FAIR-GOOD
		7	WATER ELIMINATING TOILETS	32%	32%	40%	5.1%	9 MGD	NA	NA	NA	X			X	X		MODERATE	POOR-FAIR
		8	SYSTEM PRESSURE REDUCTION						NA	NA	NA	X		X			MODERATE		FAIR-GOOD
		9	LEAKAGE AND LOSS CONTROL						NA	NA	NA	X		X			MODERATE		GOOD
		10	DUAL SUPPLY & DISTRIBUTION, SYSTEM WIDE	49%	0 TO 49%	0	15%	20MGD	YES	YES	NO		X	X	X		MAJOR		POOR-GOOD
		11	UNITIZED RESIDENTIAL RECYCLING (ASSUME UP TO 50% NEW HOUSING)	15 TO 66%	0 TO 66%	0 TO 60%	UP TO 6%	UP TO 10MGD	YES	NO	YES		X		X	X		MAJOR	POOR-FAIR

63. Providing preference to low water-using industried could reduce 1995 water demands by about 7 percent. Agribusiness is the number one industry in Nebraska and Iowa, creating a demand for food and agricultural product industries which are characteristically high water-users. The major supplier in the study area, Metropolitan Utilities District, has voiced strong support for supplying water to the agribusiness industry. Therefore this alternative was excluded. In addition the study area, relatively rich in water resources, could play an important national economic role in the future.

64. Twenty-five percent price increases by Council Bluffs in 1968 and by the Omaha Metropolitan Utilities District (MUD) in 1969 have not produced any change in water usage. A 50 percent increase aimed solely at reducing consumption would probably be publicly unacceptable. The Metropolitan Utilities District has very recently investigated altering their declining rate structure to reduce peak water use and provide more equitable charges. An increasing block rate structure was proposed to the Board of Directors but was rejected in favor of a level rate structure. This action will probably not reduce water use but will be more equitable between high volume and low volume users.

65. The only opportunity to reduce water usage by individual metering appears to be for apartments and mobile homes which total 59,000 units in the study area. Cost for installing individual meters would exceed short-term savings. Plumbing repairs are more apt to be made if the management is responsible for the water bills than if tenants pay the bills.

66. Eight-six percent of the study area's water needs are provided by the Omaha Metropolitan Utilities District and by the

Council Bluffs City Water Department. These two suppliers operate efficient systems. Therefore system pressure reduction and leakage controls are not widespread system problems.

67. Several alternative arrangements were considered for unitized residential recycling. These arrangements and their effects are detailed in Annex K of Volume V. While significant potable water and wastewater reductions can be achieved, the technology required is still in the research and development stages. While not included as part of an urban study plan, unitized residential recycling should receive continued attention and may be technically and economically feasible within the next 10-20 years.

REGIONAL PLANS

68. Four initial water supply plans were developed and evaluated. Plan I evaluates existing individual county plans with 31 rural water systems covering the non-metropolitan areas. Twenty-two treatment plants are required to serve Plan I. Plan II regionalizes Plan I to one rural water system and treatment plant per non-metropolitan county. Plan III provides further regionalization of water supplies across State lines. Within these regional plans, four urban distribution plans were developed to match the four growth concepts. Each regional plan was evaluated independently of the urban distribution plans. Plan IV considers the application of dual water systems for the new urban growth areas.

69. The present worth costs of Plans I, II, and III are given in table B-9. The costs are based on Growth Concept A. All costs are similar. Plans II and III meet all planning objectives. Plan I does not include a water system for rural Douglas and Sarpy

Counties. Since all three plans are relatively comparable in costs and in contribution to planning objectives they were retained for further consideration.

Table B-9
Present Worth Costs of Initial Water Supply Plans

	Water Supply Plan		
	I	II	III
		(millions)	
Non-Metropolitan			
Capital	85.07	74.97	70.25
O & M	24.50	22.52	18.30
Total	109.57	97.49	88.55
Metropolitan			
Capital	220.00	212.58	225.21
O & M	120.32	117.28	123.26
Total	340.32	329.86	348.47
Study Area			
Capital	305.07	287.55	295.46
O & M	144.82	139.80	141.56
Total	449.89	427.35	437.02

70. Water Supply Plan IV, featuring dual water systems, was rejected from further consideration. An economic analysis of the dual water systems using various nonpotable water supplies and for Growth Concepts A and C is given in table B-10. Each of the nonpotable supply sources was provided with only enough treatment to avoid adverse effects on the nonpotable uses of which the dual system would provide. Stormwater at Level 2 quality and wastewater at Level 3 quality were used without further treatment in the dual systems.

Table B-10
Annual Cost Comparison-Dual Vs. Conventional Systems
($1,000/yr)

Concept	Nonpotable Supply Source	Amortized Capital Cost Increase	Distribution System O&M Cost Increase	Treatment O&M Cost Differential	Net Annual Cost Increase
		(1)	(2)	(3)	(1+2-3)
A	Surface	7,978	1,417	755	8,640
	Ground	7,175	1,417	431	8,551
	Stormwater				
	Level 1	9,841	1,417	670	10,588
	Level 2	7,053	1,417	847	7,623
	Wastewater				
	Level 1	7,839	1,417	-154	9,410
	Level 2	7,408	1,417	370	8,455
	Level 3	7,053	1,417	847	7,623
C	Surface	6,189	1,003	371	6,821
	Ground	5,836	1,003	212	6,627
	Stormwater				
	Level 1	7,159	1,003	329	7,833
	Level 2	5,783	1,003	416	6,370
	Wastewater				
	Level 1	6,173	1,003	- 77	7,253
	Level 2	5,956	1,003	182	6,777
	Level 3	5,783	1,003	416	6,370

71. A thorough analysis of the dual water system concept is contained in Volume V-Annex K.

Flood Control

BOYER RIVER AT MISSOURI VALLEY, IOWA

72. Nonstructural methods considered for Missouri Valley, Iowa were flood plain zoning and flood insurance, flood proofing, and evacuation. Structural measures considered were reservoirs, channel improvements, ring levees, diversions, and combinations of the above.

73. Flood proofing would be the financial responsibility of property owners in the flood plain. Flood proofing is not attractive because the age and condition of existing development would probably preclude the major improvements required. Most of the homes in the flood plain are valued at less than $10,000.

74. The cost of evacuation was estimated at $15,000,000 and is not economically feasible. Reservoirs were rejected because of a lack of good damsites and economic feasibility.

75. Channel improvements were estimated at $6,000,000. The average annual cost of improvements would be almost twice the average annual damages. The cost of a ring levee was estimated at $7,500,000 and this alternative was rejected. A combination of structural alternatives were likewise eliminated because of costs.

76. The evaluation concluded that flood plain zoning is the only feasible alternative for Missouri Valley. Owners of existing structures in the flood plain should consider flood proofing and flood insurance.

INDIAN CREEK

77. Table B-11 contains the evaluation data for the initial alternative investigated for Indian Creek flood control.

78. Nonstructural measures considered for the Indian Creek flood control program included evacuation, flood proofing, and flood plain zoning and flood insurance. Structural methods considered were alternative reservoir systems with and without spillways, channel improvements, levees, diversions, and combinations of the above. Flood proofing and flood plain zoning, and insurance were retained for further consideration. Evacuation was rejected because of an estimated cost of over $200,000,000.

79. One large dam located north of Council Bluffs had a near favorable benefit-to-cost ratio and was retained for further analysis. Ten smaller dams located approximately coincidental with authorized Soil Concervation Service structures were also considered. This alternative had a favorable benefit-cost ratio with recreation added.

80. Four smaller dams located downstream of the 10 dams were investigated. The 4-dam system was found to provide the same degree of flood control as the 10-dam system at approximately 40 percent less cost. The 10-dam system was therefore eliminated in favor of the 4-dam system.

Table B-11
Comparative Data-Alternatives for Indian Creek

Alternative	Investment	Annual Flood Control Benefits	Benefit-Cost Ratio	% Flood Damage Reduction	Land Required, Ac.	Relocations Residential Units
Large Dam	$13,600,000	$ 816,000	0.95	87	1,013	129
Large Dam and 1% Channel	21,100,000	888,000	0.7	94	1,021	129
10 Small Dams	10,600,000	595,000	0.8	63	1,365	35
4 Small Dams	6,700,000	595,000	1.3	63	1,007	22
4 Small Dams and 1% Channel	23,200,000	881,000	0.6	94	1,015	35
1% Channel	25,300,000	838,000	0.5	89	8	13
Diversion	19,800,000	816,000	0.6	87	641	116
Evacuation	216,000,000	885,000	0.1	94	1,118	1,267
Flood Proofing	17,600,000	671,000	0.6	71	0	0
Flood Plain Management	No initial cost	109,000	0.8	12	0	0

81. The 10-dam and 4-dam alternatives were considered with and without spillways. Benefit-cost ratios for the 10-dam and 4-dam systems with perched spillways and for the 10-dam and 4-dam systems without spillways are 0.4, 0.9, 0.8, and 1.3 respectively. Therefore dams with perched spillways were rejected.

82. Channel improvements were rejected because of costs, $25,300,000, and because of disruptions that would be created with implementation. Levees were rejected because the existing congestion of buildings, street, and railroad crossings would require major disruptive relocations.

83. Diversion of the upper Indian Creek flood flows directly westward to the Missouri River was rejected due to an estimated cost of $20,000,000 and an unfavorable benefit-cost ratio.

84. Combinations of the dams and a 100-year channel were evaluated. This alternative was not found to be cost effective and in each instance lowered the benefit-cost ratio of the dams-only alternatives as indicated on table B-11.

MOSQUITO CREEK

85. A summary of the Mosquito Creek structural alternatives and their costs are given in table B-12. Average annual flood damages amount to only $100,000. All structural alternatives have a benefit-cost ratio of 0.1 or less. Therefore all structural alternatives were eliminated from further consideration. Flood plain zoning presents the best opportunity for flood plain management since most of the flood plain is still undeveloped.

Table B-12
Cost Summary of Alternatives
Mosquito Creek

Alternative	First Cost
100-Year Evacuation	$ 8,820,000
Large Dam	
Portsmouth Dam	7,800,000
County Line Dam	9,450,000
Underwood Dam	11,970,000
Chataqua Dam	14,400,000
4-Dam System	29,750,000
58 Small Dams	57,430,000
100-Year Channel	18,210,000
100-Year Levees	19,190,000

MISSOURI RIVER

86. Alternatives considered for Missouri River flood problems south of Omaha and Council Bluffs included no action, flood plain zoning, and levee construction. Zoning would be the preferred alternative if the levees are not constructed. Since passage of the Flood Disaster Protection Act of 1973, a no-action alternative could jeopardize local government's ability to qualify for Federal financial programs. No action was therefore rejected. Missouri River Levee Units L 611-614 and R-616 have favorable benefit-cost ratios and therefore were considered as part of the final water resources plans. The evaluation of these units is contained in the next section.

PLATTE-ELKHORN RIVERS

87. Structural alternatives to solve the existing flood problem were found to be economically infeasible by a wide margin. Even though flooding is frequent and covers a large area, existing average annual damages amount to only $190,000. A levee system to provide 100-year flood protection would cost approximately $1,000,000 per mile. Channel improvements are opposed by local interests and would not be compatible with the habitat and environmental qualities of the rivers. Dams, both within and outside the study area, have been considered in the past and were found to be economically unjustified.

88. It is concluded that the flood plains should be mapped and zoned. Such action would also limit urban expansion into the area, preserve its use for agriculture, and preserve its environmental setting.

PAPILLION CREEK AND TRIBUTARIES

89. The authorized Papillion Creek and Tributaries Lake Project constituted the initial plan for flood control. Late in the plan formulation phase part of the Papillion Creek system was reformulated. The reformulated alternatives are evaluated in the next section.

90. Alternatives to flood problems on tributary streams in the Papillion Creek Basin were investigated. These tributaries are Betz Ditch, Cole Creek, Hell Creek, and Mud Creek. Structural alternatives on these tributaries are not economically feasible. Cole Creek, Hell Creek, and Betz Ditch are already zoned for flood plain land uses. Mud Creek should be mapped and zoned.

Recreation

91. Initial recreation plans for the urban study consisted of the MAPA Open Space Plan, the Platte Level "B" Plan, the MAPA Missouri Riverfront Plan, the recreation portion of the authorized Papillion Creek flood control project, recreation associated with the Indian Creek flood control alternatives, and existing county plans.

92. These plans, including alternatives within the reformulation of part of the Papillion Creek flood control project, are evaluated in the next section.

SECTION C

ASSESSMENT AND EVALUATION OF FINAL ALTERNATIVES

ASSESSMENT AND EVALUATION OF FINAL ALTERNATIVES

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SECTION C

ASSESSMENT AND EVALUATION OF FINAL ALTERNATIVES

1. In this section the final alternatives are compared and evaluated in accordance with the concepts and aims of the Water Resources Council's Principles and Standards. This is achieved by assessing impacts and evaluating tradeoffs through the series of four accounts specified by the Principles and Standards.

2. Each alternative was compared with respect to its contribution to the planning objectives, its relationship to national economic development, environmental quality, social well-being, and regional development accounts, and its response to associated evaluation criteria.

The Alternative Growth Patterns

PLAN DESCRIPTION

3. A detailed plan description of the four alternative growth patterns used in the study is contained in the Plan Formulation Appendix, Annex A - Alternative Futures. Briefly the four growth patterns are:

Growth Concept A-represents a continuation of present trends in land use. That is, the continued suburbanization of the area with low density residential urban sprawl directed away from the core city.

Growth Concept B-envisions controlled expansion of urban Omaha with emphasis placed on encouraging higher density residential development, revitalizing the urban core, and developing satellite cities based on existing communities located around the fringes of the metropolitan area.

Growth Concept C-similar to B, except it does not include the satellite cities. It is primarily characterized by redevelopment of the older areas of Omaha and Council Bluffs, coupled with higher density growth on the urban fringes.

Growth Concept D-similar to Concept A, except that it assumes substantial development will occur finger-like along major transportation corridors.

CONTRIBUTIONS TO PLANNING OBJECTIVES

4. The regional planning objectives for land use and urban growth are the following:

- Promote a more compact urban development pattern.
- Promote large scale redevelopment of blighted areas.
- Promote higher density fringe development.
- Encourage mass transportation.
- Preserve existing agricultural areas.
- Promote industrial decentralization to ensure the economic stability of selected satellite cities.
- Provide for the protection of the freedom of the individual landowner.
- Provide complete individual freedom on where and how to live.
- Provide low density development to afford maximum individual privacy.

5. Growth Concept A contributes primarily to the last three planning objectives and conflicts with the other planning objectives.

In essence, continuation of Concept A would allow maximum individual freedom at increased public costs, urban blight, and energy and agricultural land consumption.

6. Growth Concept B contributes to all of the planning objectives. The higher density development would create a more efficient growth pattern and would conserve energy and land resources. Industrial decentralization to the satellite cities would ensure their economic stability and would for some, ensure that they would not become "bedroom communities" for Omaha. Concept B does not contribute to the last three planning objectives as much as Concept A, however, even under Concept B approximately 20 percent of new urban growth is assumed to occur at low densities.

7. Growth Concept C contributes to all of the planning objectives with the exception of industrial decentralization to the satellite cities. It is the most efficient growth pattern in terms of energy conservation and maximizes the use of existing capital improvements while minimizing the need for additional improvements.

8. Growth Concept D contributes to the regional planning objectives in a manner similar to Concept A.

RELATIONSHIP TO FOUR ACCOUNTS

NATIONAL ECONOMIC DEVELOPMENT (NED)

9. The NED account is a measure of changes in the value of the output of goods and services and improvements in national economic efficiency. Changes measured represent the difference between what would occur if an alternative were implemented (with condition)

and what would occur if none of the alternatives were implemented (without condition).

10. In the case of the alternative growth patterns, Concept A is the without condition; i.e. the land use pattern that is likely to occur in the absence of a change in growth policies. The other three patterns can then be measured in economic terms relative to Concept A.

11. Beneficial impacts in the NED account result from the reduced public costs required to support a growth pattern that is an alternative to Concept A.

12. In analyzing total public costs the following sub-components were included: (1) wastewater management systems, (2) water supply systems, (3) residential structures, (4) transportation systems, (5) storm drainage, (6) gas, (7) electricity, and (8) telephone. The costs were based on numerous and complex features of each item. As an overview, however, national averages expressed in 1973 dollars were used with the assumptions of present technology, construction techniques, and service standards.

13. Cost effects of wastewater management and water supply systems were developed by the consulting firms of Henningson, Durham, and Richardson and of Havens and Emerson. Other costs were taken from the Real Estate Research Corporation's <u>The Costs of Sprawl</u> sponsored by the Environmental Protection Agency, the Department of Housing and Urban Development, and the Council for Environmental Quality. The costs to serve various development patterns considered in the above report were applied to the densities envisioned

in the four growth concepts used in the urban study. All reservations stated in The Costs of Sprawl must also be applied to the costs indicated below.

14. The Costs of Sprawl divided public costs between neighborhood and community costs. Only the neighborhood costs were used in this study, for two reasons; (1) community costs vary widely from community to community, being site-specific, whereas for the most part neighborhood costs do not vary, and; (2) in the Omaha-Council Bluffs area community costs would be more affected by total population growth rather than by a growth pattern.

15. The analysis of the four growth concepts was confined primarily to Douglas and Sarpy Counties where the majority of the urban growth is to take place. Adjustments were made for Growth Concept B to reflect increased expenditures caused by the population dispersion to the satellite cities.

16. Table C-1 lists the capital cost summary to serve the four growth concepts from the present to 1995 and the present to 2020. Only those items that would show a distinction among growth concepts were included.

17. The net NED benefit to altering the current trend in land use can be readily determined by comparing the public costs for Growth Concepts A and C. The capital costs differences in public utilities and transportation amounts to about $180,000,000 over the next 50 years. Residential construction costs differences based on smaller dwelling unit sizes would amount to about $660,000,000.

Table C-1

Public Cost Effects of Alternative Growth Concepts

	Concept A		Concept B		Concept C		Concept D	
	1995	2020	1995	2020	1995	2020	1995	2020
			Land (Acres in Thousands)					
Urban Land Required	49.0	72.0	22.0	30.0	29.0	43.0	45.0	71.0
			Public Costs[1] (All Costs in Millions)					
Utility Costs								
Water Lines[2]	113.4	175.0	97.5	142.0	90.0	136.0	117.6	176.0
Sewer Lines[2]	56.0	91.0	45.0	64.0	41.0	62.0	54.0	83.0
Storm Drainage	84.8	135.5	67.5	99.8	62.0	98.8	80.9	134.7
Gas Lines[3]	8.7	13.8	7.0	10.5	6.5	10.4	8.3	13.8
Electricity[3]	25.0	33.7	19.0	31.7	17.0	30.3	21.7	34.3
Telephone	14.9	23.7	9.7	20.0	12.9	20.0	14.4	23.6
Streets and Roads[4]	205.8	328.6	175.3	266.8	165.0	264.4	199.7	327.6
Residential Construction	2,200.0	3,507.0	1,884.0	2,855.0	1,791.0	2,840.0	2,126.0	3,491.0

[1]Capital costs to service population at 1995 and 2020 estimates.

[2]Does not include water and sewage treatment costs which are relatively equal for the four concepts.

[3]Distribution costs only.

[4]Does not include major arterials such as expressways, interstates, etc.

18. Energy cost savings in transportation (see Supporting Technical Reports Appendix - Annex B) could be as much as $9,000,000 per year if Concept C were followed instead of Concept A.

19. Costs attributable to residential energy use and the costs for operation and maintenance of metropolitan services were not determined. Concept C would show a reduction in these costs over Concept A according to The Costs of Sprawl.

ENVIRONMENTAL QUALITY (EQ)

20. The EQ account includes measures of environmental enhancement, degradation, and destruction. Items included in the EQ account include the alternative's impact on open space, air, water and land quality, and irreversible commitments of resources to future uses.

21. Table C-2 lists the environmental effects of the four alternative growth patterns. About 30,000 acres of land could be saved for open space (agriculture) use if Growth Concept C were followed instead of Growth Concept A.

22. Growth Concept A would produce the greatest amount of water pollution caused largely by soil erosion from developing areas.

23. Overall, Growth Concept A requires the largest commitment of energy resources because of dependence on the automobile, and emphasis on single-family dwellings. Growth Concepts B and C, being controlled concepts, offer the advantage of guiding growth away from environmentally sensitive areas. Currently, under Growth Concept A, urban developments are occurring in the wooded bluff lands and flood plains of the Platte and Elkhorn Rivers. These same areas are prime wildlife habitat.

Table C-2
Environmental Effects of Alternative Growth Concepts

	Concept A	Concept B	Concept C	Concept D
Air Pollution	Total amount increases with increased sprawl due to dependence on auto. Concentration in any one area decreases due to low concentration of activities.	Similar to C.	Total amount decreases with increased density due to less travel time and distance. Concentration in particular area may increase due to increased concentration of activities.	Similar to A.
Water Pollution (Erosion)	Greatest amount due to largest percentage of disturbed soils.	Similar to C.	Substantially less than A due to differences in developed acres.	Similar to A.
Noise Pollution	Higher transportation activity; however, noise is diffused over larger area. Decrease in neighborhood noise.	Planned buffers and dwelling location can isolate traffic noise. Traffic on arterials less subject to stop and go motion. Increase in interior noise levels due to multi-family units unless adequately constructed.	Higher density causes concentrated traffic flows. Noise sensitive land uses should be located along quiet side streets. Interior noise similar to B.	Traffic noise irritation likely unless dwelling adequately buffered.
Resource	Greatest water use due to effort to keep lawns green. Single family units greatest user of natural gas and electricity. Higher gasoline use due to distances traveled and infeasibility of mass transit for all residential areas.	Water use similar to C. Gas and electricity use similar to C. Good potential for mass transit results in decreased gasoline consumption.	Lowest water use due to decreased lot size and increased multi-family units. Lowest user of gas and electricity. Greatest potential for mass transit.	Water, gas, and electricity use similar to A. Potential for mass transit along transportation corridors could reduce gasoline consumption.

SOCIAL WELL-BEING (SWB)

24. The social well-being account includes measurement of changes in the quality of life, health and safety; changes in educational, cultural, and recreational opportunities; and injurious displacement of people and community disruption.

25. No conclusions could be reached in the relationships of the four alternative growth patterns to the SWB account. While the social effects were not evaluated in the urban study, The Costs of Sprawl does provide some indications regarding public health and safety.

26. Under Growth Concept B or C, the number of travel accidents is expected to be less than under Growth Concepts A or D. This is caused largely by a reduction in the number of vehicle miles traveled.

27. The crime rate could be expected to be slightly higher under Growth Concepts B or C than under A or D. The differences are attributable, in part, to the greater opportunity for surveillance afforded by single-family dwellings as contrasted to inner public areas such as hallways of apartment complexes. This problem could be resolved by both security systems and design features.

REGIONAL DEVELOPMENT ACCOUNT (RD)

28. The RD account describes the changes created by the alternative in the region's income, employment, population distribution, and economic base.

29. For the entire region, significant differences in the above factors are not discernible among the four growth patterns. There

are significant differences among the four patterns if each community is considered a region. Under Concept B, part of the future urban population would be distributed to satellite cities. Income, employment and economic base would increase in the satellite cities under Concept B relative to the other concepts. This could be significant since the alternative for several of the satellite communities is to become "bedroom-communities" for metropolitan Omaha.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

30. The two most significant associated evaluation criteria are the alternative's acceptability and certainty. These two criteria are interrelated.

31. Citizens who participated in the public involvement activities of this study selected Growth Concept C as their first preference and Growth Concept B as their second preference.

32. Although the four growth patterns stimulated the most public interest of any of the urban study functional areas, it should not be assumed the entire public would accept a controlled growth pattern. Almost everyone agreed that urban sprawl (Concept A) was bad; however, controlling growth raises the issue of individual freedoms versus the common good. The important test of acceptability will come when local officials begin to make the crucial but controversial decisions regarding zoning and growth controls. It must be admitted that the majority of the public has been silent in the urban growth control issue.

33. The certainty of altering the trends forecast (Concept A) of future land use cannot be determined at this time. Controlling growth is the subject of several court cases now being heard in

various parts of the country. The outcome of these cases and the amount of public desire to achieve the regional planning objectives for land use and urban growth will decide the certainty of adopting Growth Concept C.

34. The political problems associated with reversing the outward growth trend would be difficult to overcome. The problem is one of regional competition for new industry and new residents. Many citizens and officials interviewed felt that a restricted growth policy in and around one city in the metropolitan area would simply shift the sprawl to another city that did not restrict growth. Thus, it appears that controlled growth concepts must be regionally coordinated and implemented. A political analysis conducted as part of the institutional studies indicates that the atmosphere of cooperation among cities in this area is not conducive to the adoption of a regional growth policy at this time.

Wastewater Management

AREAWIDE (POINT SOURCE) PLANS

PLAN DESCRIPTION

35. Four alternative wastewater management plans were formulated from the initial eight plans discussed in Section B. There are three basic plans plus land treatment options for the major urban treatment plants. Plans 1, 2, and 3 are equivalent to Plans I, II, and VII from Section B. Plan VIII from Section B was renamed

as a Land Treatment Option that could be used with any of the final plans but is included here in combination with Plan 3 to form an all land irrigation plan. The plans for treatment of wet weather sources of pollution are discussed separately in this section.

36. Table C-3 gives a brief description of each of the plans. The difference between Plan 1 and Plan 2 is in the amount of extension of the Papillion Creek interceptor sewer. Plan 3 evaluates land treatment for the minor-urban and rural communities. Three alternative land irrigation areas were considered for the Land Treatment Option. Option 1 would use land areas in the Todd Valley until 1995 and land areas in both the Todd Valley and Blue River areas after 1995. Table C-4 lists the projected wastewater flows to each of the land irrigation areas under Option 1. Under Option 2, all flows go to the Todd Valley and under Option 3, all flows go to the Upper Blue River Basin.

Table C-3
Summary Comparison of Alternative Wastewater Management Plans

	Plan 1	Plan 2	Plan 3	Plan 3 Option
Plan Description	Papillion Creek Interceptor extended to Bennington, Elkhorn, and Gretna. 44 treatment plants: 3 major urban, 7 minor urban, and 34 non-urban. All plants treat to required level of treatment and discharge to the receiving stream.	Bennington, Elkhorn and Gretna have their own plants. 47 treatment plants: 3 major urban, 10 minor urban, and 34 non-urban. All plants treat to required level of treatment and discharge to the receiving stream.	Land treatment by minor and non-urban plants after Level 1 treatment. Additional minor urban plant at Boys Town. Major urban plants treat to required level of treatment and discharge to Missouri River.	All plants except for the Council Bluffs plant provide Level 1 treatment and discharge to land treatment systems. Major urban plants land treatment options: 1. Blue River and Todd Valley 3. Blue River only Council Bluffs plant must provide required level of treatment and discharge to Missouri River.

Table C-4
Land Treatment Option 1 - Wastewater Flows

Year	Todd Valley	Upper Blue River	Total
1985	69,000	0	69,000
1995	84,000	0	84,000
2020	84,000	48,000	132,000

37. Effluents from the Council Bluffs (Mosquito Creek) major urban plant are not included under any of the Land Treatment Options. The high salt concentration of the Council Bluffs plant's effluents puts the sodium absorption ratio (SAR) and conductivity above acceptable limits in Nebraska. The Nebraska Water Quality Standards state that the SAR value and conductivity shall not be greater than a C3-S2 Class irrigation water as shown in figure 25 of the Agricultural Handbook 60, U. S. Department of Agriculture. The SAR and approximate conductivity values for each of the major urban plants and their combinations are shown in figure C-1. Council Bluffs effluent alone is greater than the irrigation water standard. The combination of the major urban effluents brings the overall SAR within acceptable limits, however, the relatively low flow from the Council Bluffs plant (16 M.G.D. by 1995) and the increased costs involved indicate that conveyance of the effluent across the Missouri River to join the other two major urban flows in not cost-effective.

CONTRIBUTIONS TO PLANNING OBJECTIVES

38. The planning objectives for wastewater management are the following:

- Meet State water quality standards in all streams in the study area.

- Reduce or eliminate pollution from all waste sources.

- Meet 1977 effluent requirements and 1983-1985 goals of PL 92-500 for all publicly-owned sewage treatment plants.

- Provide an additional sewage treatment capacity of 115 M.G.D. by 1995 and 185 M.G.D. by 2020 in the study area.

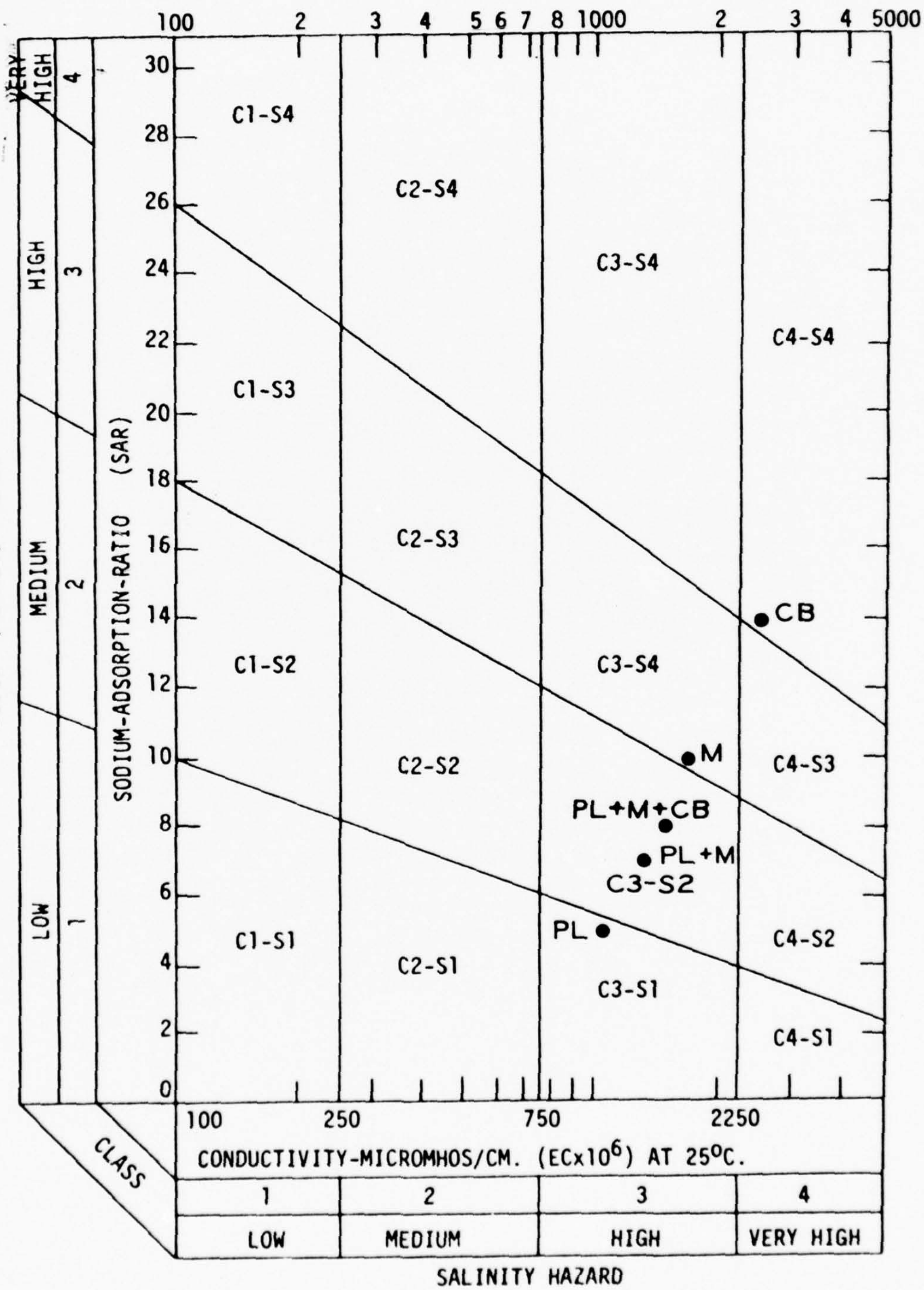
- Provide for recycling of wastewater effluents.

- Provide for non-structural approaches to wastewater management.

39. All of the areawide wastewater management plans are designed to meet the first objective. Under Plan 2, Elkhorn, Bennington, and Gretna remain independent of the Papillion Creek sewage system. Level 2 treatment of Elkhorn's, Bennington's, and possibly Gretna's wastewater would be required to meet State water quality standards comparable with the other plans. Level 2 is the minimum treatment level included for these communities in Plan 2.

40. Reduction or elimination of pollution is an objective that relates more to treatment level than to the wastewater plan. As discussed later, Plan 3 with a Major Land Treatment Option would appear to be the most cost-effective plan for eliminating the discharge of pollutants.

41. All plans are phased to meet the 1977 effluent requirements and the 1983 and 1985 goals of PL 92-500. The most cost-effective methods to achieve these planning objectives are discussed later.



PL = Omaha Papillion Creek Plant

M = Omaha Missouri River Plant

CB = Council Bluffs Mosquito Creek Plant

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MAJOR URBAN IRRIGATION
WATER QUALITY

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

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42. All plans are sized to provide adequate facility capacities based on waste flow projections for 1995 and 2020. Only Plan 3, and Plan 3 with a Major Land Treatment Option provide an opportunity for the recycling of wastewater effluents. The water supply portion of the urban study has found no cost-effective method of recycling the effluents of Plans 1 and 2.

43. The interceptor sewers included in Plan 1 conform to Growth Concepts A and D. The interceptor sewers included in Plans 2 and 3 conform to Growth Concepts B and C. Since these concepts contribute to more of the regional land use planning objectives, it follows that Plans 2 and 3 contribute more in a multi-objective context than does Plan 1.

RELATIONSHIP TO FOUR ACCOUNTS

44. Beneficial and adverse impacts of the four final alternative plans are evaluated and displayed in four accounts. The national economic development (NED) account includes a measurement of the output of goods and services on a national basis. This account concludes with a computation of net NED benefits. The environmental quality (EQ) account includes measurements of changes in environmental quality. The social well-being (SWB) account includes measurements of the plan characteristics that may affect people directly. The regional development (RD) account includes a measurement of the distribution of beneficial and adverse impacts among various geographic subdivisions of the study region.

45. National Economic Development (NED). The national economic development account for the alternative plans is shown on table C-5. Beneficial NED impacts include the value of increased output of goods and services in the form of irrigation water and nitrogen

Table C-5
National Economic Development Account - Wastewater Management

	Footnotes 1/	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
I. National Economic Development												
A. Beneficial Impacts: ($ million)												
1. Value of increased outputs of goods and services												
Irrigation	3, 5, 7, 9	-	-	-	-	-	-	1.0	1.0	1.0	10.0	10.0
Nitrogen	3, 5, 7, 9	-	-	-	-	-	-	2.3	2.3	2.3	16.7	16.7
2. Value of output from use of unemployed labor resources in construction	1, 5, 7, 9	5.4	7.1	8.5	5.1	7.0	7.9	5.1	7.1	7.5	6.5	7.6
3. Total NED Benefit		5.4	7.1	8.5	5.1	7.0	7.9	8.4	10.4	10.6	33.2	34.3
B. Adverse Impacts: ($ million)												
1. Project cost												
Papillion Creek		77.4	114.9	122.8	68.3	106.3	112.4	70.5	106.3	111.6	94.5	109.0
Missouri River		65.3	93.4	107.0	69.6	99.7	114.9	69.6	99.7	114.9	83.6	92.2
Council Bluffs		23.7	32.5	36.0	23.0	32.7	36.2	23.8	32.7	36.2	36.2	36.2
Additional areas		29.0	36.6	45.5	29.0	36.6	45.5	37.6	37.6	37.6	37.6	37.6
Total project cost	3, 5, 7, 9	195.4	277.4	311.3	190.9	275.3	309.0	201.5	276.3	300.3	251.9	275.0
2. Total NED cost		195.4	277.4	311.3	190.9	275.3	309.0	201.5	276.3	300.3	251.9	275.0
C. Net NED Benefit		-190.0	-270.3	-302.8	-185.8	-268.3	-301.1	-193.1	-265.9	-289.5	-218.7	-240.7

1/ Footnotes indexed at the end of Table C-33.

and the value of output from the use of unemployed labor resources in construction. The irrigation benefits occur only when land irrigation is included in a plan.

46. The benefits of land irrigation are the savings that would be realized by the farmer if he were to use the wastewater instead of obtaining water from an irrigation well. Savings realized by the farmer would be:

- The cost of drilling an irrigation well;
- Part of the cost of an irrigation pump;
- Part of the cost on an irrigation engine;
- Interest on investment;
- Fertilizer costs;
- Irrigation labor;
- Maintenance and repairs on irrigation equipment; and
- Fuel.

47. Cost data were taken from "The Costs of Center Pivot Irrigation Now", Irrigated Agriculture, January 1975, pp 12-15. The value of effluent delivered to a center pivot irrigation system is considered equal to the alternative means of providing the water and nitrogen. In this case the alternative source of water is a well and the alternative source of nitrogen is liquid nitrogen.

48. The following presents the fixed costs of providing well water to a center pivot system in the Todd River Valley and Upper Blue River Basin.

		Total Cost	Annual Cost $/Acre
Irrigation well (25 yr., str. line, no salvage)			
	200 ft. @ $22/ft.	$4,400	
	80 yd. gravel @ $4.25	340	
	dig and fill pit	100	
		$4,840	$ 1.46
Irrigation engine (12 yr., str. line, no salvage)			
	100 ft. column @ $25/ft.	$5,600	$ 2.80
Irrigation engine (12 yr., str. line, no salvage)			
	73 hp	$3,705	$ 2.32
Interest on investment			
	$10,815 x 50% x 10%	$ 541	$ 4.06
Sub-total, estimated annual fixed costs			$10.64

49. The following presents the estimated annual variable costs of providing well water and 80 pounds of nitrogen per acre to center pivot systems.

	Annual Cost	Annual Cost $/Acre
Fertilizer - 80 lbs. nitrogen @ $0.30		$24.00
Fuel (900 hrs. operation, @ 3.0 gal. diesel fuel/hr. @ $0.33/gal	$891	$ 6.70
Maintenance and repairs	$154	$ 1.16
Sub-total, estimated annual variable costs		$31.86
Sub-total estimated annual fixed costs		$10.64
Total estimated annual costs		$42.50

50. The distribution of this total annual cost between providing the water and the nitrogen is as follows:

Water	\$18.50/acre
Nitrogen	\$24.00/acre
Total	\$42.50/acre

51. If the wastewater is not provided to the center pivot system, the farmer would have to spend approximately \$42.50 per acre foot to pump the water from a well and add 80 pounds of nitrogen, which is the amount of nitrogen contained in one acre-foot of combined effluents of Omaha's Missouri River and Papillion Creek treatment plants.

52. The per-acre savings were converted to annual dollar amounts by a staging system whereby the number of acres being irrigated are increased by a certain amount at 5-year intervals. These savings were then converted to a present-worth value.

53. The savings for fertilizer would result from the recycle of nitrogen to the land treatment areas. The benefit was computed based on a 15-inch per acre application rate for the irrigation water. This would recycle about 100 pounds of nitrogen per acre per year. The present cost for nitrogen is 30 cents per pound, and this amount was used to compute the benefit for the nitrogen. Since 155 to 160 pounds of nitrogen are required to raise a corn crop (100 bushels per acre), additional nitrogen will be required equivalent to the amount presently used minus 100 pounds per acre. No savings were included for the addition of phosphorous, potassium, sulfur, and zinc due to the low amounts of these fertilizers used in the land application areas. The above method, termed the alternative cost method, of determining the present value of irrigation

water and nitrogen was used for the NED Account for all land treatment areas. A second method of computing benefits would be the increased income method. The alternative cost method assumes that ground water is an available water source alternative; which could be an erroneous assumption in the Upper Blue River Basin which has a declining water table.

54. The value of irrigating with the effluent can also be determined by subtracting the extra costs associated with developing and operating an irrigation system from the increased income resulting from irrigation with effluent. Cost data from "The Costs of Center Point Irrigation Now", Irrigated Agriculture, January, 1975 indicate that extra annual irrigation fixed and operating costs amount to \$62.80 per acre. Extra income is a factor of the increased productivity, value of the product, and value of the nutrients applied. Using 80 pounds of nitrogen per acre-foot at \$0.30 per pound, the equation becomes:

$$V = XY + \$24 - \$62.80$$

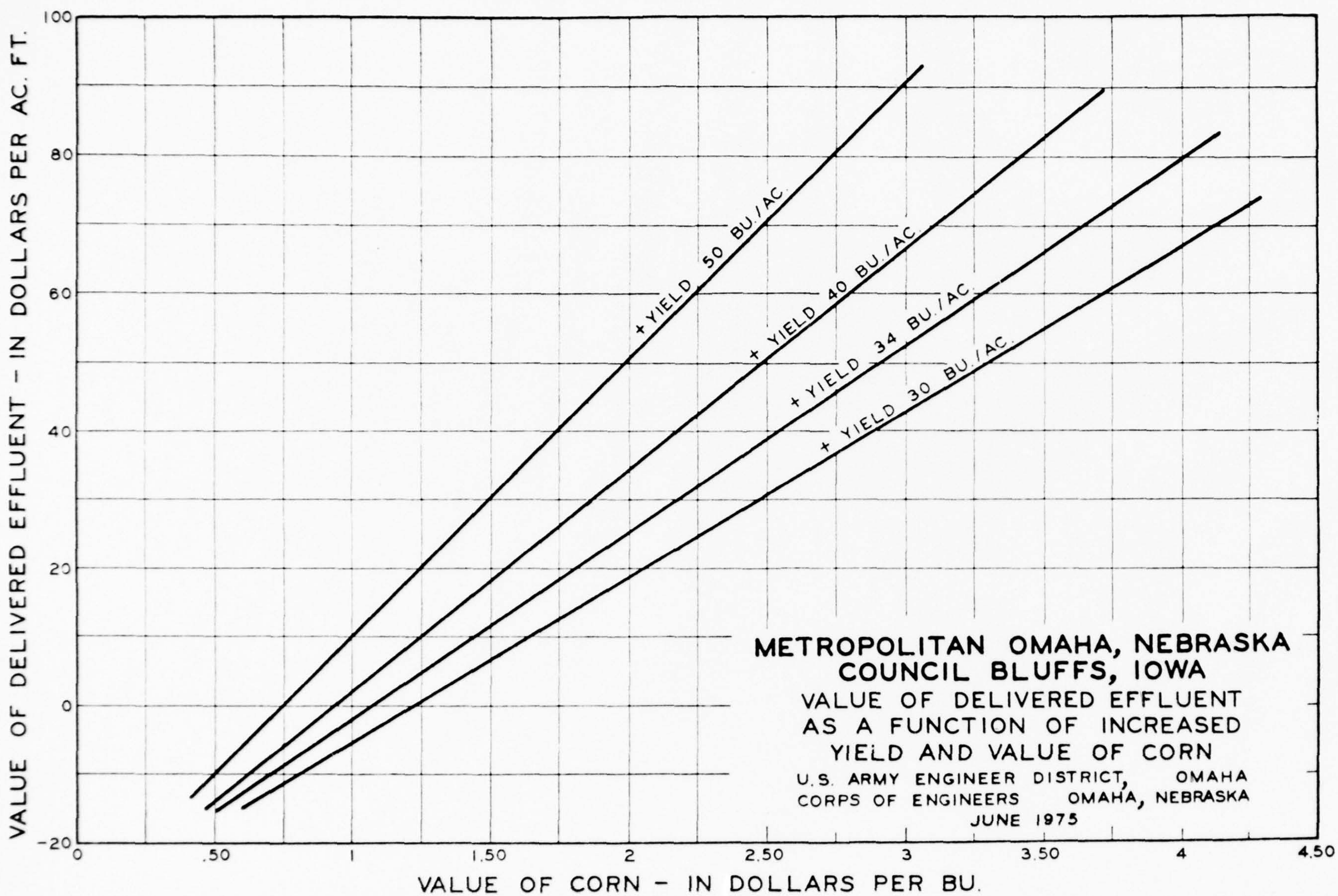
where:

V = Value of effluent

X = Increased product yield

Y = Value of product

55. Figure C-2 is an expression of the value of delivered effluent as a function of increased yield and value of corn assuming one acre-foot of irrigation water is applied. The difference between irrigated and non-irrigated corn averages between 30-40 bushels to the acre. At October 1975 corn prices of \$2.75 per bushel, the value on an acre-foot of delivered effluent would range from \$38.00 to \$58.00. The above method is appropriate for areas with a water shortage like the Upper Blue River Basin. It was not used in the


VALUE OF DELIVERED EFFLUENT - IN DOLLARS PER AC. FT.
VALUE OF CORN - IN DOLLARS PER BU.
100
80
60
40
20
0
-20
0
.50
1
1.50
2
2.50
3
3.50
4
4.50
+ YIELD 50 BU./AC.
+ YIELD 40 BU./AC.
+ YIELD 34 BU./AC.
+ YIELD 30 BU./AC.
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
VALUE OF DELIVERED EFFLUENT
AS A FUNCTION OF INCREASED
YIELD AND VALUE OF CORN
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

NED Account because of the relative instability of agricultural commodity prices.

56. A category under NED benefits, "Value of Output Resulting from External Economics", was not shown in table C-5 since no value could be placed on this category. This is not to imply that there are no such economic considerations. Improved water quality would have some definite economic impacts, some of which would be of the nature of an external economy. Examples of such benefits on which values cannot be placed are:

• Improved water quality in the Missouri River which could result in increased recreational use which in turn could increase demand for water-recreation related goods and services, an external economy.

• Reduced water treatment costs for lowering the pollutant levels of the water for industrial users and municipal systems located downstream.

57. The water quality changes in the Missouri River would not be significant enough to measure the above external economies.

58. The NED second benefit, contained in table C-5, would be the value of use of unemployed labor resources in construction of the new facilities. The value of this benefit was arrived at by assuming that 50 percent of the capital expenditure would be for labor and that 10 percent of the labor force would be from the unemployed ranks.

59. Adverse NED Impacts. The adverse impacts consist entirely of the project costs. The project costs presented in table C-5 are costs of the plans, broken down into four categories; Papillion Creek, Missouri, Council Bluffs, and "Additional Areas". The Papillion Creek category always includes the minor urban community costs for Gretna, Bennington, and Elkhorn. The "Additional Areas" category refers to the seven other minor urban plants and the non-urban treatment plants. Capital and O&M costs of the plans can be obtained from Volume V - Annex H. Since Plan 1 would encourage urban sprawl and Plans 2, 3, and Plan 3 Option would not, Growth Concept A costs were used for Plan 1 and Growth Concept C costs were used for Plans 2, 3, and 3 Option.

60. Included in the costs for the conventional treatment plants, Plans 1 and 2, are the present worth values for the capital and O&M costs for the treatment plants and interceptors. Plan 3 costs include the costs for conventional treatment at the major urban plants and the land treatment costs for the minor and non-urban communities. The land treatment costs for the minor urban and non-urban communities include the costs for Level 1 (secondary) treatment, conveyance to the land treatment sites, purchase of the land, underdraining the land, storage facilities, and irrigation facilities. Plan 3 Option costs include the costs for conventional treatment at the Council Bluffs plant and land treatment for the other plants. The minor and non-urban costs for land treatment are the same as those used in Plan 3. The costs included for the major urban facilities are the costs for secondary treatment and the costs associated with conveyance to the irrigation facilities. These latter costs include the costs of conveyance, storage, and pumping and distribution to the center pivot systems. Since irrigation is presently practiced in the land treatment areas,

it was assumed that private ownership should continue and that the treated effluent would become the irrigation water. This methodology is consistent with the alternative cost method of computing the present value of the irrigation benefits. The present worth and capital costs of all components of the land treatment plan are given in Volume V - Annex H. Underdrainage was not included since the depth to ground water are presently 60 to 200 feet in the major urban land treatment areas.

61. The NED costs for Plan 3 Option include approximately $12,000,000 for the Level 3 (zero discharge) treatment at the Council Bluffs-Mosquito Creek plant. As previously mentioned, this plant was excluded from the land treatment options in the final plans.

62. The costs include all unconstructed elements of the MAPA Comprehensive Water Pollution Control Plan. These costs include the construction of a secondary expansion to the Omaha-Missouri River treatment facility, construction of the new Omaha-Papillion Creek treatment facility, and miscellaneous interceptor construction. For the minor urban and non-urban communities, the costs include construction of new facilities capable of achieving the 1977 effluent standards except in instances where treatment facilities have recently been constructed. Volume V - Annex H should be consulted for the capital and O&M cost breakdown for each community.

63. In order to meet higher levels of treatment, additional treatment costs must be incurred. In the case of Level 2 treatment, additional costs, above the Level 1 costs, of $74,800,000 to $84,400,000 are required to meet Level 2 treatment by conventional methods in the entire study area. Another $23,600,000 to $33,300,000

must be spent, in addition to the above costs, to reach Level 3 treatment. This means that about $100,000,000 to $120,000,000 must be spent to go beyond the 1977 requirements of secondary treatment by all wastewater treatment facilities.

64. The land treatment plans reduce the above costs. Plan 3 Option is the least costly plan and the costs are lower for land treatment than for Level 2 or 3 by conventional methods. For example, Plan 3 Option 3 requires that an additional $84,100,000 must be spent in order to achieve Level 3 treatment, assuming that Plan 2 would be followed for level 1 treatment.

65. Capital expenditures for Level 1 and Level 2 treatment were assumed to be initiated in 1977 with plant replacement and expansions in 1995. Capital expenditures for Level 3 treatment were assumed to be initiated in 1985. The capital expenditures were present valued to 1975.

66. Operation and maintenance values were determined for 1975, 1977, 1985, 1995, and 2020 for the plant capacities and treatment levels at the respective dates. These annual values were present valued to 1975.

67. Capital operation and maintenance costs for the land treatment system were assumed to start in 1985 and phased in increments through 2020.

68. It should be noted that Level 1 treatment would probably be sufficient to meet the 1983 "fishable-swimmable" water quality requirement of PL 92-500 with regard to treatment plant discharges.

Therefore, there is no substantial cost difference between achieving the 1977 and 1983 requirements of PL 92-500.

69. Level 2 treatment was defined on the basis of applying the best practical treatment technology solely from a treatment process standpoint with no relationship to water quality. Since the capital, operation, and maintenance costs for Level 2 were assumed to be initiated in 1977, the present worth values cannot be used for a time-phased comparison to achieve higher degrees of treatment. Future revisions of the urban study can apply the capital, operation, and maintenance expenditures in Volume V-Annex H to any future time frame to determine the present value of time phasing to treatment Level 2. For instance if Level 2 treatment is initiated in 1983 the present worth costs in table C-5 can be reduced by approximately $20,000,000. A comparison between Level 1 treatment and the alternatives to achieve Level 3 treatment, either by treatment plants or by one of the land treatment options, permits a direct comparison of the costs to achieve the 1985 zero-discharge goal by time phasing the necessary facilities and operation and maintenance expenditures.

70. Net NED Impacts. Total NED costs were subtracted from total NED benefits in order to obtain the net NED benefits. The resulting values were all negative and indicate that the NED benefit decreases as treatment level goes up for each plan.

71. For treatment Level 1 (secondary treatment) Plan 2 has the lowest negative NED benefits. However, there is little NED difference between Plans 1, 2, and 3 at treatment Level 1. Plan 3 Option achieves treatment Level 3 (zero discharge) and is therefore

not comparable to the other plans at Level 1. As the treatment level increases, Plan 3 Option becomes decidedly more favorable.

72. NED Plan. The NED plan is the plan with the highest net NED benefit. Since Level 1 treatment at the major urban plants appears to be all that is required (discussed under environmental quality) and the major urban costs make up the major portion of the project costs, Plan 2 (Level 1) is the NED plan. If "zero discharge" is required, then one of the land treatment options becomes the NED plan.

73. Environmental Quality (EQ). The environmental impacts of the four wastewater management plans are summarized in table C-6. The impacts on water, land, and air quality were evaluated.

74. Water. Ground water quality should not be affected under any of the plans. Depth to the ground water table ranges from 60 to 200 feet in the land irrigation areas. Approximately 5 feet of soil under an application rate of 1-to 4-inches per week is required to provide a high degree of wastewater renovation. Soils in the land irrigation areas are all deep, exceeding 5 feet. Bedrock is generally encountered below 20 feet.

75. The removal of nutrients from wastewater has been extensively investigated in the past. Removals of 80 to 99 percent can be expected for phosphorous and nitrogen. At the land application rate of 15 inches per year, removals should be near the top of this range. As the application rate increases, the removal efficiencies will decrease. Of particular importance will be the removal of nitrogen. Nitrate-nitrogen, NO_3, is the form that

Table C-6
System of Accounts - Wastewater Management

	Footnotes 1/	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
II. Environmental Quality												
A. Water Quality:												
1. Ground water	2, 4, 8, 10	See Text - Paragraph 74.										
2. Surface water												
a. Pollutant loads (1995) (1000 tons/year)	3, 5, 8, 9											
(1) SS		5.2	3.1	0.4	5.2	3.1	0.4	4.9	2.9	0.4	0.2	0.2
(2) BOD		4.1	2.1	1.0	4.1	2.0	1.0	3.9	1.8	1.0	0.6	0.6
(3) PO_4		1.0	0.25	0.02	1.0	0.25	0.02	1.0	0.25	0.02	0.01	0.01
(4) N (total)		4.8	4.7	1.2	4.8	4.7	1.2	4.6	4.5	1.1	0.7	0.7
b. Stream Quality (2020) (mg/l)	3, 5, 8, 9											
(1) Missouri River (6000 cfs)												
(a) SS		49	48	48	49	48	48	49	48	48	50	50
(b) DO		5-6	6-7	6-7	5-6	6-7	6-7	5-6	6-7	6-7	6-7	6-7
(c) PO_4		0.38	0.15	0.13	0.38	0.15	0.13	0.38	0.15	0.13	0.13	0.13
(d) Ammonia N		0.9	0.1	0.1	0.9	0.1	0.1	0.9	0.1	0.1	0.1	0.1
(2) Big Papio (4 cfs)												
(a) SS		50	50	50	46	45	43	50	50	50	50	50
(b) DO		7	7	7	2-7	607	7	7	7	7	7	7
(c) PO_4		0.16	0.16	0.16	1.21	0.41	0.15	0.16	0.16	0.16	0.16	0.16
(d) Ammonia N		0.1	0.1	0.1	2.7	0.3	0.1	0.1	0.1	0.1	0.1	0.1
(3) West Papio (0.5 cfs)												
(a) SS		50	50	50	33	27	20	50	50	50	50	50
(b) DO		7	7	7	0-7	4-7	7	7	7	7	7	7
(c) PO_4		0.16	0.16	0.16	4.67	1.24	0.12	0.16	0.16	0.16	0.16	0.16
(d) Ammonia N		0.1	0.1	0.1	11.1	1.0	0.2	0.1	0.1	0.1	0.1	0.1

Table C-6
(Cont'd)
System of Accounts - Wastewater Management

	Footnotes 1/	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
c. Biological life	2, 4, 8, 10											
(1) Improvement in aquatic species diversity		See Text - Paragraphs 88-90										
(2) Effect on terrestrial species		See Text - Paragraphs 91-95										
(3) Effect on waterfowl		See Text - Paragraphs 91-95										
B. Air Quality	2, 4, 8, 10	See Text - Paragraphs 96 and 97										
C. Land Quality												
1. Physical												
a. Number of treatment plants	1, 6, 7, 9	44	44	44	47	47	47	48	48	48	48	48
b. Length of conveyance facilities (miles)	1, 6, 7, 9	89	89	89	73	73	73	132	132	132	195	195
c. Land requirements in 2020 (acres)	1, 6, 7, 9											
(1) Irrigation												
(a) 15"/yr		0	0	0	0	0	0	18,018	18,018	18,018	165,759	165,759
(b) 33"/yr		0	0	0	0	0	0	8,190	8,190	8,190	75,345	75,345
(2) Storage		0	0	0	0	0	0	665	665	665	3,615	3,615

Table C-6
(Cont'd)
System of Accounts - Wastewater Management

	Footnotes[1/]	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
d. Land treatment impacts	2, 5, 8, 10											
(1) Runoff potential		See Text - Paragraph 100										
(2) Water table rise		See Text - Paragraph 100										
(3) Erosion increase		See Text - Paragraph 100										
e. Construction impacts	1, 5, 8, 9	See Text - Paragraph 101										
f. Corn production increase (1,000 /yr)	2, 4, 8, 10	0	0	0	0	0	0	216	216	216	2,582	3,171
2. Chemical												
a. Concentration of salts and chemicals in soil	2, 5, 8, 9	See Text - Paragraphs 104-107										
b. Amount of nitrogen fertilizer provided (tons/yr)	1, 5, 7, 9											
1985		0	0	0	0	0	0	318	318	318	3,038	3,038
2020		0	0	0	0	0	0	560	560	560	5,744	5,744

1/ Footnotes indexed at the end of table C-33.

ammonia nitrogen is converted to during oxidation processes. This form of nitrogen is also easily leached through the soil and can contaminate the ground water. This condition could result in a violation of the Safe Drinking Water Act Standards. The current application rate of commercial nitrogen in the land irrigation areas is about 150 pounds per acre per year. An acre-foot of wastewater effluent would apply about 80 pounds of nitrogen. An application rate of approximately 24 inches would be equivalent to the commercial application of nitrogen. For the major land irrigation areas, an application rate of 15 inches is suggested which would apply about 100 pounds of nitrogen per acre per year. Therefore, the nitrogen in the wastewater effluent would not, in itself, be the cause of increased nitrate contamination in ground water supplies relative to current nitrogen applications.

76. The small volume of effluents produced by the minor urban and rural communities in relation to the large volumes of ground water should not appreciably increase nitrate levels even at application rates exceeding 24 inches per year.

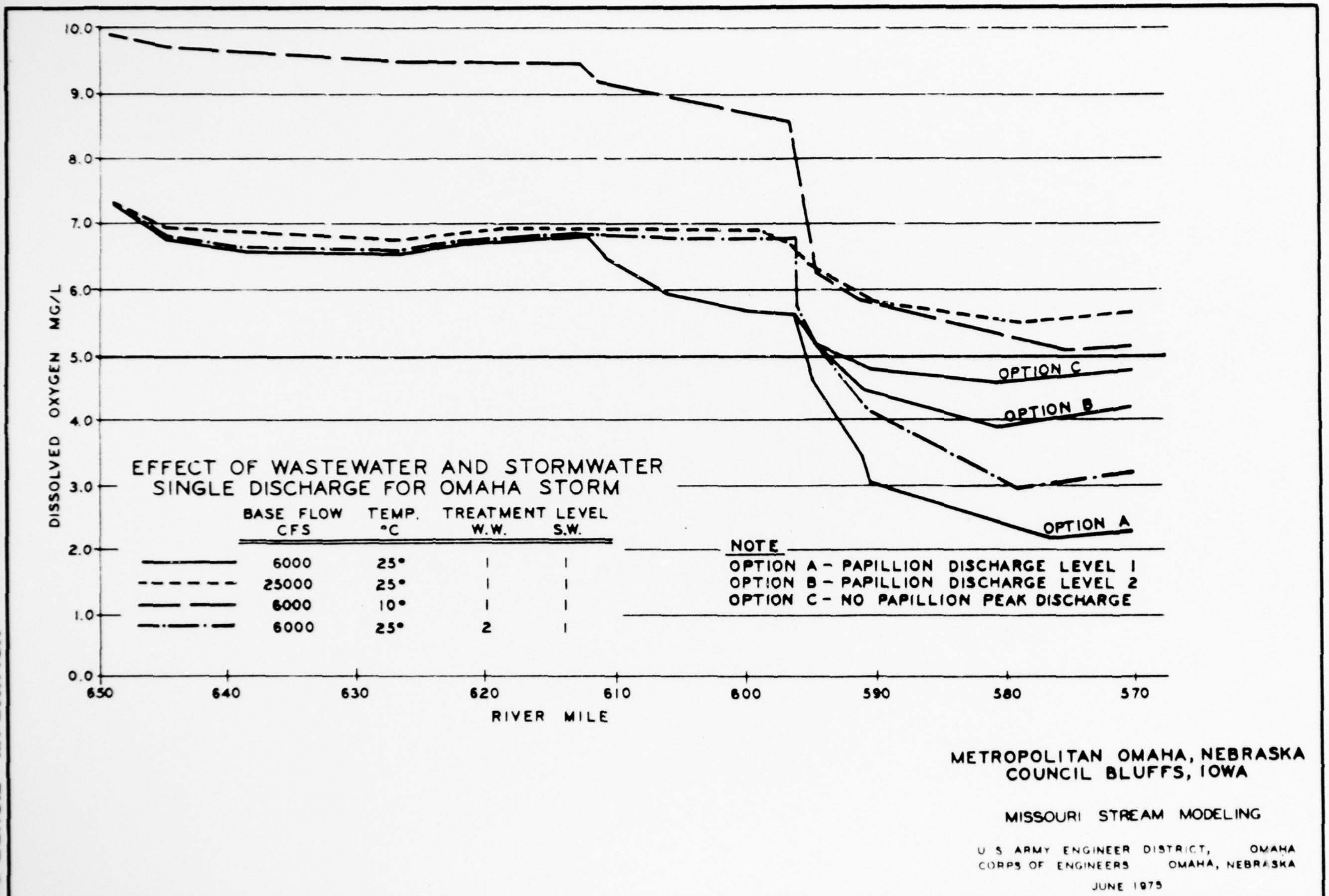
77. In order to determine the level of treatment required to meet dissolved oxygen (DO) surface water quality standards, stream modeling of dissolved oxygen levels was performed. The effects of wastewater on the DO level of the Missouri River was determined at two flows, 25,000 c.f.s. and 6,000 c.f.s. The 25,000 c.f.s. represents the normal summer flow of the Missouri River at Omaha. The 6,000 c.f.s. represents the projected 2020 minimum summer flow, based on operational studies of the Missouri River with maximum ultimate development of the river as a water supply source for irrigation and energy development. The 6,000 c.f.s. figure is nearly equivalent to the present winter 7-day, 10-year low flow of 7,000 c.f.s.

78. Figure C-3 shows that the dissolved oxygen standard of 5 mg/l for the Missouri River is met at normal summer flow and temperature conditions with Level 1 treatment. Under normal conditions and with current analysis techniques, there would appear to be little merit in requiring treatment levels above secondary. The standard also was not contravened for low flow (6,000 c.f.s.) and low temperature conditions(10°C). Figure C-3 shows that future withdrawals of water from upstream locations would require that Level 2 treatment be implemented to meet water quality standards at the low-flow, high-temperature conditions.

79. The effects of wastewater discharges under Plan 2 on dissolved oxygen in the Big Papillion and West Papillion Creeks are shown in figures C-4 and C-5. The major waste inputs are from the communities of Elkhorn and Bennington. Figure C-4 analyzes the 2020 wastewater discharges under flows generated by Growth Concepts A, C, and D with figure C-5 analyzing the 2020 discharges under Growth Concept B. At Level 1 (secondary) treatment, serious contraventions are indicated under all conditions. Since the effects are so dramatic, contraventions can be assumed to occur earlier than 2020, very probably prior to 1995.

80. Figures C-4 and C-5 indicate that some contravention could occur even with Level 2 treatment. Slight process modification should alleviate this problem without requiring Level 3 treatment.

81. The effects on surface water quality were evaluated in the terms of annual residual pollutant loads and on in-stream quality for the Missouri River, Big Papillion, and West Papillion Creeks.



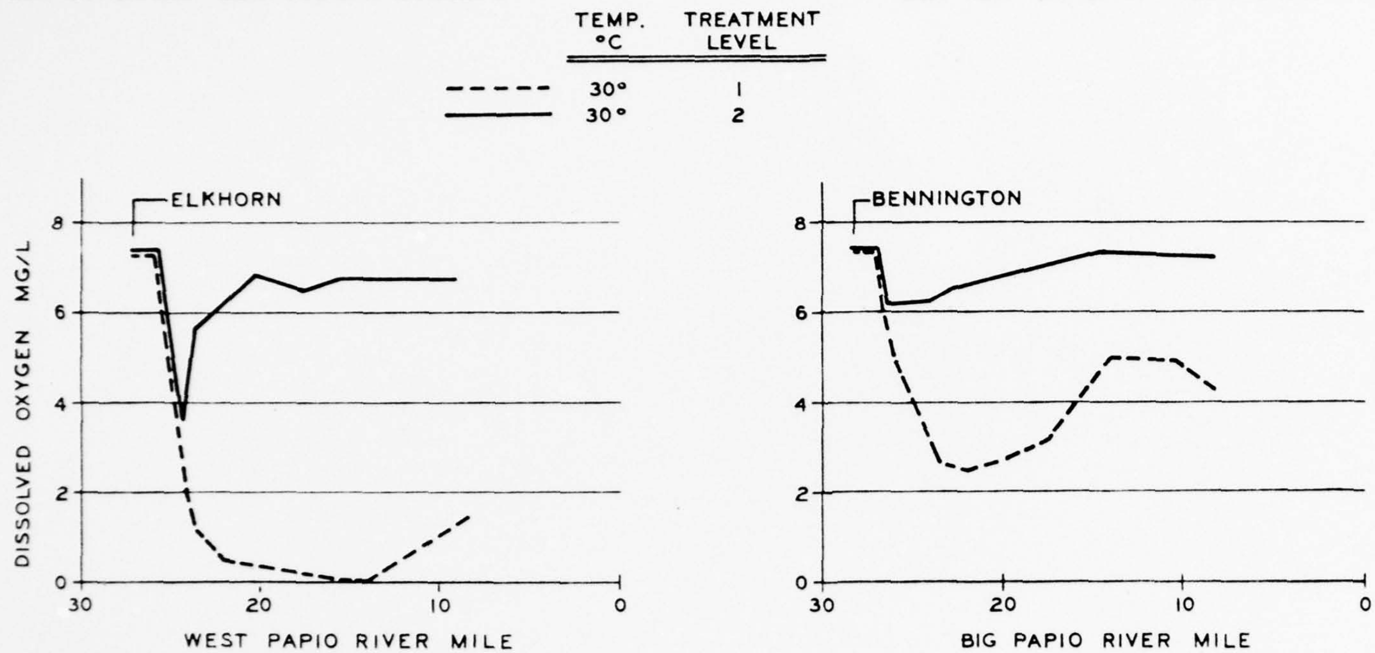
EFFECT OF WASTEWATER AND STORMWATER
SINGLE DISCHARGE FOR OMAHA STORM
BASE FLOW CFS
TEMP. °C
TREATMENT LEVEL
W.W.
S.W.
6000 25° 1 1
25000 25° 1 1
6000 10° 1 1
6000 25° 2 1
NOTE
OPTION A – PAPILLION DISCHARGE LEVEL 1
OPTION B – PAPILLION DISCHARGE LEVEL 2
OPTION C – NO PAPILLION PEAK DISCHARGE
OPTION A
OPTION B
OPTION C
DISSOLVED OXYGEN MG/L
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
650
640
630
620
610
600
590
580
570
RIVER MILE
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
MISSOURI STREAM MODELING
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

EFFECT OF ELKHORN
WASTEWATER EFFLUENT

LOW FLOW CONDITION – LOW GROWTH CONCEPT

EFFECT OF BENNINGTON
WASTEWATER EFFLUENT

LOW FLOW CONDITION – LOW GROWTH CONCEPT



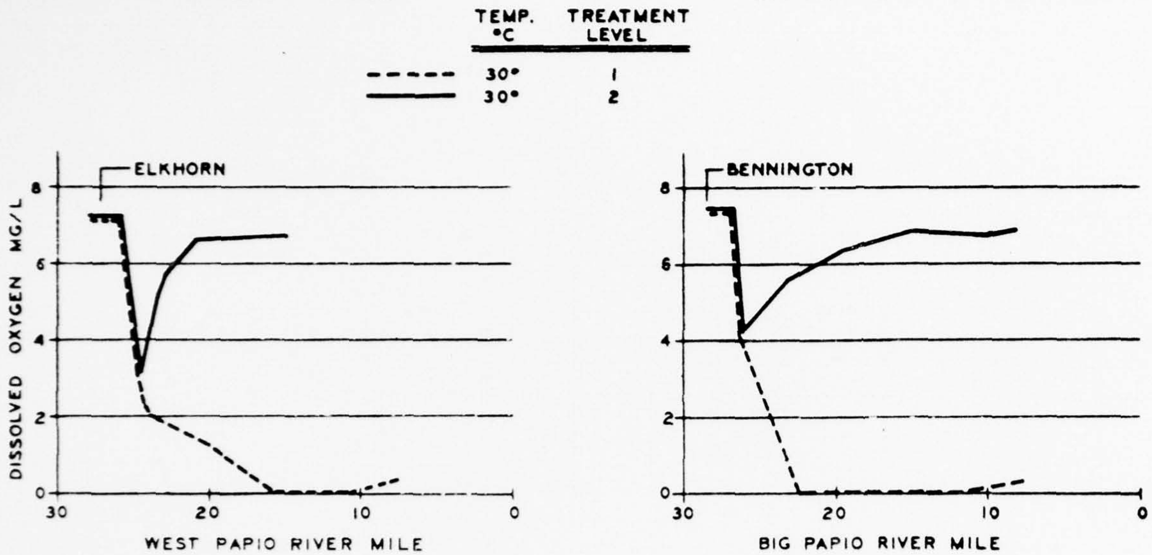
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

PAPILLION STREAM MODELING

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

EFFECT OF ELKHORN
WASTEWATER EFFLUENT
LOW FLOW CONDITION-HIGH GROWTH CONCEPT

EFFECT OF BENNINGTON
WASTEWATER EFFLUENT
LOW FLOW CONDITION-HIGH GROWTH CONCEPT



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

PAPILLION STREAM MODELING

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

82. The annual pollutant loads were developed for each treatment level according to the established effluent criteria for suspended solids, biochemical oxygen demand, phosphorous, and total nitrogen. As the level of treatment increases, the pollutant load decreases as indicated in table C-6.

83. Stream quality effects for suspended solids, phosphorous, and ammonia-nitrogen were determined by adding the wastewater effluent concentrations at each treatment level to concentrations in the stream prior to the entry of the wastewater. The stream quality values, before wastewater discharge, were obtained from STORET data on the streams. An arbitrary initial suspended solids value of 50 mg/l was also used. The base values for ammonia-nitrogen and phosphorous used for West Papillion Creek were assumed to be the same as those used for Big Papillion Creek. The final pollutant levels were arrived at by multiplying the concentrations of the pollutants in the wastewater and streams by their corresponding flows, summing these products, and dividing by the sum of the flows. The effects of the wastewater were more pronounced in the two Papillion Creek branches than the Missouri River since they had lower base flows for dilution. The stream water quality values are those for low-flow conditions so they reflect the worst conditions that could occur.

84. The stream quality values shown in table C-6 indicate Missouri River quality is not greatly affected by Level 1 treatment discharges. The smaller streams, Big and West Papillion Creeks, are noticeably affected under Plan 2. It appears that Level 2 treatment will be required at Bennington and Elkhorn in order to keep ammonia at desirable levels. This would be required in Plan 2 only since in the other plans Elkhorn and

Bennington's effluents are treated to higher levels of discharge into the Papillion Creek interceptor for treatment at the Papillion Creek major urban plant with subsequent discharge to the Missouri River.

85. In summary, for the Missouri River little change in water quality could be expected from increasing the treatment from Level 1 (secondary) to Level 3 under all plans. Big Papillion Creek and West Papillion Creek could be adversely effected under Plan 2 if Level 2 treatment is not provided at Elkhorn and Bennington.

86. The above statements are based primarily on modeling for dissolved oxygen only. Other constituents discharged into the Missouri River (average flow 16,150) do not produce changes which result in non-compliance with water quality standards. This is not to imply that other constituents are not important. Ammonia toxicity could eventually become a problem according to some researchers who have investigated temperature, pH, un-ionized ammonia, and toxicity relationships.

87. Nebraska's water quality standards call for no more than 2.9 mg/l NH_3-N and Iowa's call for no more than 2.0 mg/l NH_3-N. Some researchers have indicated that significantly more restrictive ammonia standards should be adopted. The 2020 discharge from the three major treatment plants in the study area would increase ammonia levels in the Missouri River to about 0.9 mg/l assuming a 6,000 c.f.s. river flow. Ammonia concentrations currently average 0.1 mg/l. Therefore, under current Nebraska and Iowa standards, there should be no ammonia violation. Further research may, however, cause revision in the States' water quality standards. If ammonia becomes critical, Level 2 treatment would be required.

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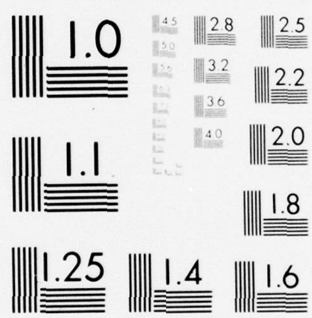


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Ammonia toxicity and dissolved oxygen are critical in the Papillion Creek and other drainage basins. Level 2 treatment is therefore required for Bennington and Elkhorn and possibly other communities. Whether or not treatment beyond the second level will be required for additional communities will be determined through the States' 303(e) plans and through legislation at the national level. The 1985 effluent limitations for Elkhorn and Bennington according to the Missouri River Tributaries 303(e) Plan are 30 mg/l BOD with an ammonia limitation of 5.5 mg/l for Elkhorn and 12.0 mg/l for Bennington.

88. The biological life of the streams in the area would be affected. There should be some improvement in diversity of aquatic species. As the level of treatment increases, more improvement should be noted. Only moderate improvement would be noted at best since there are other sources of pollution other than wastewater from treatment plants. Also, the diversity of species currently present is so low that drastic changes in diversity probably would not occur. In Plan 1, the removal of all treatment plant flows from the Papillion Creek system should show moderate improvement no matter what level of treatment is practiced. Under the land treatment plans, Plan 3 and Plan 3 Option, all treatment plant flow would be removed from the smaller streams so that more diversity of aquatic species should occur than under discharges of effluent to the streams.

89. It is difficult at this time to determine what changes in biological life would occur by providing treatment in excess of secondary for discharges into the Missouri River. The low diversity and pollutant-tolerant species currently found downstream of Omaha are the result of years of raw and primary sewage discharges

caused by malfunctioning sewer systems, combined sewer overflows, and inadequate industrial and municipal waste treatment.

90. According to a 1967-1968 study performed by the then Federal Water Quality Administration, the bottom sediment in a 54-mile stretch of the Missouri River downstream of Omaha contained only pollutant-tolerant organisms. Implementation of secondary treatment on all wastewaters, correction of the sewer system bypasses and overflows will certainly improve the aquatic eco-system of the Missouri River.

91. Terrestrial biological life should be affected primarily by the construction of the wastewater management system selected. The main impacts should be noticed in areas where interceptor and pipeline construction occurs. More pipelines and interceptors are required for the land treatment plans and Plan 1. With proper management, according to the U. S. Fish and Wildlife Service, the ppipeline construction required for Plan 3 Option could improve the environment for wildlife species in the future. The linear configuration of the pipeline route lends itself to a situation, where, with plantings of native grasses and woody plant species, many miles of "edge" habitat could be provided. "Edge" habitat provides an interface with other habitat types, a condition which is highly beneficial to maintaining diverse wildlife populations. A long-term easement of the pipeline route would maximize the benefits. Buffer zones around the storage lagoons in the land treatment plans could provide a needed habitat for small wildlife species.

92. Construction of the 90-inch pipeline to the land irrigation areas should not disturb any significant wildlife habitat with the exception of when it crosses the Platte River. The Platte River is an annual spring and fall migration stopover for waterfowl species. Construction of this portion of the pipeline could be carried out between May and September to lessen the disturbance effect on the waterfowl.

93. According to studies conducted by the Nebraska Game and Parks Commission, the lands in the two major irrigation areas have a low value for wildlife habitat. The majority of the land is classified as either cropland or potential cropland. Wildlife habitat is generally limited to narrow edges along streams located in the Upper Blue River basin.

94. The Upper Blue River basin once contained numerous small wetland areas. These marsh areas are critical as breeding grounds for maintaining or enlarging duck population and also a host of other waterbirds. According to the U. S. Fish and Wildlife Service few of these areas remain. In Butler, Polk, Seward, and York Counties, about 1,229 acres of wetland areas have been destroyed with only 7.1 percent, 14.5 percent, 6.7 percent, and 15.8 percent, respectively, of the original wetlands remaining. The land treatment systems could be designed to avoid the few remaining wetlands. In addition, land irrigation would also probably create some additional wetland areas caused by ponding of the effluents in depression areas.

95. According to the U. S. Fish and Wildlife Service, the buffer zones around the storage lagoons could benefit wildlife species

and would be a welcomed addition to the sparsely located wildlife niches found in the land irrigation areas.

96. Air. Air quality would not be appreciably affected under any of the plans. There is a possibility that a slight odor problem could exist in land disposal areas, but proper Level 1 treatment and land disposal procedures should keep this to a minimum.

97. Air quality in the vicinity of the major urban treatment plants could be adversely affected by the discharge from the incinerators used to destroy the organic portion of the sludges produced during wastewater treatment. As the level of treatment increases, the amount of sludge will increase, requiring larger incinerators and more discharge. Proper air pollution control equipment and operation should keep the air pollution potential to a minimum.

98. Land. Plans 1 and 2 would not have any appreciable effect on the existing land quality. The only effects that would occur would be to the land taken for treatment facilities and for construction of the conveyance pipelines.

99. Plan 3 and Plan 3 Option would have some major effects on the land quality within the seven-county area as well as at the major urban wastewater irrigation sites. The land at the disposal sites would be affected as well as strips of land to these sites where the pipelines are constructed. The amount of land affected ranges from about 9,000 acres to 170,000 acres, depending upon the treatment rate used and the plan used.

100. A major factor in determining the impacts of land treatment is the land treatment application rate. Runoff and erosion potentials increase as the application rate increases. The rise in the level of ground water increases as the treatment rate increases. In the case of the Blue River basin, this latter effect is desirable since the ground water table is presently declining.

101. Construction impacts are higher for the plans which call for more pipelines since the construction of the pipelines would be disruptive to the environment during construction and for a period or years after construction. As discussed previously, proper construction and use of the pipeline and its right-of-way should minimize and, in the long run, enhance the environment for wildlife.

102. Wastewater irrigation has a positive effect on the amount of crops that could be produced. The increased water and nutrient levels should improve the quantity of crops produced per acre. Based on "Nebraska 1973 - Preliminary County Estimates and State Agricultural Data", an increase in corn production can be computed for the land treatment areas. In the minor urban disposal areas, irrigation of corn resulted in an increased production of 24 bushels per acre. Increases of 28 bushels per acre in the Todd Valley and 40 bushels per acre in the Blue River basin were recorded. More land could also be used for production if water was made available in areas presently lacking adequate water for crops.

103. An estimate of the increase in corn production is presented in table C-6. The figures presented are based on the increase in yields for the three land treatment areas presented in the previous paragraph. It was assumed that 50 percent of the irrigated land would be in corn for the first time.

104. The application of wastewater effluent to land has an effect on the chemical properties of the soil. Concentration of the salts in the soil could increase to levels that would make the land unsuitable for crop production.

105. In an EPA technical bulletin entitled "Evaluation of Land Application Systems" (March 1975), levels of total dissolved solids (TDS) were presented which could be detrimental to the yields of various crops. A total dissolved solids concentration of 1,400 mg/l can be tolerated by corn with no effect on yield and 1,600 mg/l can be tolerated by soybeans. Two other crops grown in the land treatment regions are sorghum and wheat. They also have high TDS tolerances, 1,728 mg/l for sorghum and 1,984 mg/l for wheat, with no loss in productivity. If rotation of crops were to be practiced with clover or alfalfa included in the rotation, levels of 576 mg/l and 832 mg/l can be tolerated by clover and alfalfa, respectively, with no loss in productivity. Minor and nonurban TDS levels are about 500 mg/l and the Papillion and Missouri River plants combined flow contain about 900 mg TDS/l.

106. The application of wastewater containing heavy metals could have detrimental effects on the soil and crops. The same EPA land treatment report presents some recommended maximum levels of trace metals for irrigation waters. Based on preliminary data, the levels of several of the trace elements at the Missouri River plant are too high for irrigation. The city of Omaha has been conducting research on the source of heavy metals in order to reduce the levels being recorded in the effluent at the Missouri River plant. Those interested in implementing land treatment should check with the city of Omaha Public Works Department on the present status of heavy metal monitoring and research. Heavy metals generally can be removed

by industrial pre-treatment. Heavy metal removal by pre-treatment should be an integral part of a well-managed wastewater system.

107. Clogging of the soil with suspended solids and microbiological growth could be a problem. Alternate periods of wet and dry conditions as well as tillage should alleviate any problems. The lower application rate of 15 inches of water per-acre per-year would also reduce any potential clogging problems.

108. On the positive side, the nutrients recycled by wastewater irrigation would result in a lower need for commercial fertilizers for crop production. The wastewater nutrients are applied at a slow, continuous rate prior to and during the growing season. Therefore, the nitrogen that is applied by wastewater irrigation should be used more efficiently than commercial fertilizer nutrients, which are applied once a year. The overall amount of nutrients required to produce the crop could be decreased since those applied are used more efficiently. An example of the inefficiency of the application of commercial fertilizers is the loss of fertilizer that occurs under spring application followed by heavy rains. It has also been reported that one-third of all applied nitrogen fertilizer is changed to nitrogen gas and released to the atmosphere, thereby adding to the loss of commerical fertilizer.

109. Social Well-Being (SWB). The social well-being impacts include the value of plan characteristics which are felt directly by the individual. These impacts can affect the individual by altering his living conditions or by changing his living expenses.

110. The first impact under social well-being affects living conditions. Better wastewater treatment will improve the area waters

for water-related recreation purposes. The higher the level of treatment, the greater the improvement. The types of water-related recreation that would improve would most likely be fishing, boating, picnicking, and sight-seeing. Body contact recreation is highly unlikely due to the high and turbulent flow of the Missouri River and the low flow and deep, steeply-sloped channels of Papillion Creek and its tributaries.

111. The majority of the recreation improvement will occur with implementation of secondary treatment and connection of system bypasses and overflows. Recreation potential can be expected to increase only slightly, if at all, with implementation of treatment levels beyond secondary.

112. Other social well-being impacts can best be depicted by indicating the effects on the living expenses of the residents of the study area. Total treatment costs per customer per month are shown for the four wastewater management plans in table C-7. These costs reflect only those which could be incurred by sewage treatment for domestic flows. The total costs were distributed between residential and industrial customers based upon the average daily flows of both customers. The actual costs incurred by industry should be based upon pollutant loadings as well. The costs cannot be compared directly to present sewer bills since the present sewer bills are for all sewage treatment costs as well as sewer construction and maintenance costs. Present sewage treatment billings average about $4 per customer per month. The costs shown in table C-7 are average monthly costs for 1995 and these costs could increase the average monthly sewer bill by $1.88 to $3.58, depending on the plan and treatment level. The costs do not include the Federal portion of the construction costs.

Table C-7
System of Accounts - Wastewater Management

	Footnotes[1/]	Plan 1			Plan 2			Plan 3			Plan 3 Option	
		Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3	Option 1	Option 3
III. Social Well-Being												
A. Water-Related Recreation	2, 5, 8, 9	See Text - Paragraph 110.										
B. Treatment Costs (1995) ($/customer-month)	2, 5, 7, 9											
1. Energy (@ $.01 kw-hr)		0.25	0.36	-	0.25	0.36	-	0.26	0.37	-	0.96	1.42
2. Chemicals		0.56	1.11	-	0.56	1.11	-	0.56	1.09	-	0.66	0.66
3. Total cost												
a. Cost per month		1.93	2.91	3.35	1.88	2.85	3.32	1.88	2.85	3.31	3.26	3.58
b. Percent of income		0.2	0.3	0.4	0.2	0.3	0.4	0.2	0.3	0.4	0.4	0.4
C. Nitrogen Recycle Benefit (1995) ($/customer-month)	2, 5, 8, 10	0	0	0	0	0	0	.06	.06	.06	.48	.48

1/ Footnotes indexed at the end of Table C-33.

113. The costs for energy and chemicals are presented in table C-7 to show that they comprise a significant portion of the operation and maintenance costs, and in turn, the average monthly cost. It is interesting to note that from about 85 to 95 percent of the average monthly cost is for operation and maintenance. Because the local portion of the capital costs is only 12.5 percent of the total capital costs, the monthly capital cost per customer is low.

114. Because energy use is becoming more critical from an energy shortage standpoint, the amount of energy to be used in wastewater treatment could affect the amount of energy available to the citizens of the study area. The daily amount of energy required for each of the plans is shown on table C-8.

Table C-8
Energy Requirements for Wastewater Treatment
(1995 Megawhr/day)

Plan	Level	Energy Required
1	1	222
1	2	315
3 Option 1	3	843
3 Option 3	3	1,244

115. Energy requirements increase significantly for the land treatment plans as illustrated in table C-8. Under Plan 3 Option, the land treatment areas are from 35 to 100 miles away from the treatment plants. Pumping requirements are very high to pump this distance, which also involves an elevation increase of 150 to 600 feet above the treatment plants. Energy requirements for Plan 2 and Plan 3 are similar to Plan 1.

116. The use of chemicals is important in order to conserve the natural resources of the world. Plan 3 Option is more chemical-conserving than the other three plans at the high levels (Levels 2 and 3) of treatment. Table C-9 compares the chemical requirements for Level 1 and 2 treatment at the treatment facilities with the chemical requirements for the major land irrigation option.

Table C-9
Chemical Requirements for Wastewater Treatment
(1995 Daily Average in pounds/day)

Chemical	Level 1[1/]	Level 2[1/]	Land Treatment Option[2/]
Alum (as Al^{+3})	0	8,339	981
Lime (as $Ca(OH)_2$)	0	26,410	3,476
Sodium Carbonate	0	1,494	0
Polymer	0	562	68
Lime (as CaO)	25,643	32,293	26,243
Ferric Chloride	12,008	8,840	11,492
Chlorine	9,020	6,758	8,565

1/ Plan 1, Growth Concept A

2/ Council Bluffs plant provides Level 2 treatment, Growth Concept A

117. The higher levels of treatment at treatment facilities require an overall increase in chemical usage with the exception of two chemicals. The amount of ferric chloride required for sludge conditioning is reduced as are the chlorine requirements for disinfection.

118. To show the value of nitrogen that would be recycled in land treatment instead of being wasted, a per customer per month cost savings is shown in the social well-being account. If the farmers

were willing to pay the treatment plants the present rate for nitrogen, the reductions in the study area treatment costs would be those shown.

119. Regional Development (RD). The Regional Development account is displayed on tables G-3 through G-13 of Volume III - Annex B - Wastewater. The annex should be consulted for a discussion of the Regional Development account.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

120. Important associated evaluation criteria are the plans acceptability, certainty, and reversibility.

121. Acceptability relates primarily to the plans featuring land irrigation. In several previous wastewater management studies, in other parts of the country, land irrigation with wastewater effluents has been bitterly opposed by residents in the land irrigation areas. This does not appear to be the case in the land irrigation areas selected for Plan 3 and Plan 3 Option. While the public involvement strategy approached land irrigation with some caution, no adverse comments have been received from the public. At both the local and State levels, endorsement of continuing studies leading to implementation of such a concept have been received, most noteworthy of which were endorsements from the Nebraska Natural Resources Comission and the Upper Blue River Basin Natural Resources District. Part of the apparent acceptance stems from the agricultural base of both Nebraska and Iowa, the amount of irrigation currently practiced, the critical need for supplemental water supplies in the Upper Blue River basin, the increasing cost of fertilizers, and the support of environmental groups. In addition, placing more emphasis on irrigation design

criteria rather than disposal design criteria minimized most of the adverse impacts associated with land application of wastewater.

122. Certainty is a criterion that will affect the selection of a plan. The wastewater treatment system needed to achieve secondary treatment has been adopted by local officials, approved by State and Federal agencies, and is in the process of being implemented. The urban study has not uncovered any reason for altering the current plans.

123. The major distinction between Plan 1 and Plan 2 is in the regionalization of the wastewater collection system. The two interceptor configurations relate to the four growth concepts and involve the same uncertainties as discussed previously under the alternative growth patterns.

124. Uncertainty does exist with regard to alternate treatment requirements. The limited water quality analyses that were performed in the urban study indicate that for most treatment facilities secondary treatment will suffice to protect water quality and will meet the 1985 water quality goal of Public Law 92-500.

125. If the zero discharge goal is excluded, then it is certain that either Plan 1 or Plan 2, with some limited application of Plan 3, will be implemented. Parts of Plan 3 will be implemented if proven cost-effective in the Section 201 Facilities Plan for each minor urban and rural treatment facility. While the land irrigation part of Plan 3 is attractive from a regional viewpoint, an in-depth analysis of each individual treatment facility was beyond the scope of the urban study Many of the nonurban treatment facilities also could employ the use of stabilization pond

techniques which were found to be less expensive than treatment plant technology and possibly less expensive than land irrigation systems, depending on the size of facility required.

126. The land application components of the plans offer less reversibility than the treatment plant components. The main irreversible feature is the transmission pipelines to the land irrigation sites. Once installed, the pipelines would serve few other practical functions othen than to convey wastewater to the application areas. Should events occur to cause termination of land irrigation, the pipelines would be a lost investment. Treatment plants on the other hand allow for some process modification should changes be required.

OMAHA-MISSOURI RIVER BYPASSES AND COMBINED SEWER OVERFLOWS

PLAN DESCRIPTION

127. Five final plans for evaluation were presented as alternative solutions for the combined sewer overflows from the Omaha-Missouri River sewerage system. For the purpose of this evaluation, two additional alternatives will be evaluated. These two alternatives are do-nothing and rehabilitation of the present system. The do-nothing alternative is not acceptable from a pollution control standpoint but was included for comparison purposes. The rehabilitation of the present system alternative was included since implementation of this alternative reduces the total pollutant load considerably by insuring that all dry-weather flow receives treatment. This alternative would not be entirely acceptable as a pollution control alternative since the overflows would not be treated.

All seven of the alternatives are described and their impacts are summarized in table C-10. For a detailed plan description, Volume III - Annex B - Wastewater should be consulted.

<u>CONTRIBUTIONS TO PLANNING OBJECTIVES</u>

128. The planning objectives for the Omaha-Missouri River sewerage system were to reduce pollution of the river by eliminating system dry-weather bypasses and abating combined sewer overflows.

129. For the system bypasses, the objective was to provide enough system reliability so that 100 percent of the dry-weather flows receive secondary treatment.

130. For the combined overflows, the initial planning objective was to provide a minimum of secondary treatment for the 1-year design storm. This objective was later revised to include consideration of alternatives that would provide a level of treatment necessary to meet water quality standards. Greater than secondary treatment and design storms greater than the 1-year storm were also evaluated as discussed in Annex J of Volume V.

131. The do-nothing alternative contributes to none of the planning objectives and was therefore, rejected.

132. Rehabilitation of the existing systems includes the installation of eight grit removal and pumping facilities along the Missouri River interceptor. This alternative contributes significantly to the planning objectives by eliminating the bypassing of raw, undiluted sewage to the Missouri River.

Table C-10

Plan Description and Significant Impacts of Alternative Omaha-Missouri River Co

	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
A. Plan Description	Existing system.	Automated gate control at the overflow locations. Dual pumping and grit removal facilities.	Buried storage at overflow points with rough screening, sedimentation, and chlorination.	Diked storage along levee with secondary treatment.
B. Significant Impacts	Continued pollution of the Missouri River with raw sewage, both dry-weather flow and wet-weather overflows. State water quality standards are violated.	Eliminates pollution by dry-weather bypasses due to system breakdowns and post-storm waiting periods to reset overflow gates. State water quality standards are violated.	Removes approximately 40 percent of the BOD and 70 percent of the suspended solids from the most concentrated portion of the overflows. Requires little surface area since the reservoirs will be buried. Should have little aesthetic impact.	Removes about 65 percent of the BOD and 90 percent of the suspended solids from all stormwater from storms up to th 1-year storm. State water quality standards maintained. Potential for odor problems if aerators fail. Close proximity to population. Uses considerable riverfront land.
C. Plan Evaluation				
1. Contributions to planning objectives	None	All dry-weather flows are sent to the sewage treatment plant.	Partially meets the goal of meeting water quality standards. All combined sewer flows are tested up to the 1-year storm.	Water quality standards met. All combined sewer flows are treated up to the 1-year storm.
2. Relationship to the four national accounts				
a. NED				
(1) Beneficial impacts ($ million)	0	0.3	11.5	2.4
(2) Adverse impacts ($ million)	0	5.5	230.6	98.9
b. EQ				
(1) Aesthetics	Undesirable	Slight improvement	Moderate improvement	Greatly improved
(2) Water quality standards met	No	No	Close	Yes
(3) Land requirements	0	Minimal	Minimal-buried storage.	214 acres

Table C-10

ant Impacts of Alternative Omaha-Missouri River Combined Sewer Plans

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
omated gate con- l at the overflow ations. Dual ping and grit oval facilities.	Buried storage at overflow points with rough screening, sedimentation, and chlorination.	Diked storage along levee with secondary treatment.	Deep tunnel north to ground-level storage with secondary treatment.	Excavated storage north-deep tunnel to ground level storage south with secondary treatment.	Deep tunnel to mined storage with secondary treatment.
inates pollu- n by dry- ther bypasses to system akdowns and t-storm waiting iods to reset rflow gates. te water quality ndards are lated.	Removes approximately 40 percent of the BOD and 70 percent of the suspended solids from the most concentrated portion of the overflows. Requires little surface area since the reservoirs will be buried. Should have little aesthetic impact.	Removes about 65 percent of the BOD and 90 percent of the suspended solids from all stormwater from storms up to the 1-year storm. State water quality standards maintained. Potential for odor problems if aerators fail. Close proximity to population. Uses considerable riverfront land.	Same removals as Alt. 2. State water quality standards maintained. Potential of odors if mechanical equipment fails; proximity to low density populations. Uses Iowa land to store Omaha wastewater.	Same as Alt. 4A.	Same removals as Alt. 2. State water quality standards maintained. All facilities below ground; no odor potential.
dry-weather ws are sent to sewage treatment nt.	Partially meets the goal of meeting water quality standards. All combined sewer flows are tested up to the 1-year storm.	Water quality standards met. All combined sewer flows are treated up to the 1-year storm.	Same as Alt. 2.	Same as Alt. 2.	Same as Alt. 2.
0.3	11.5	2.4	12.7	7.6	31.0
5.5	230.6	98.9	149.7	133.5	189.6
ht improvement	Moderate improvement	Greatly improved	Greatly improved	Greatly improved	Greatly improved
No	Close	Yes	Yes	Yes	Yes
Minimal	Minimal-buried storage.	214 acres	120 acres	142 acres	Minimal

Table C-10
(Cont'd)
Plan Description and Significant Impacts of Alternative Omaha-Missouri Ri

	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
c. SWB				
(1) Cost per customer per month ($)	0	.02	1.04	1.48
d. RD				
(1) Net benefits ($ million)				
(a) Local	0	-0.4	- 23.1	-55.2
(b) State	0	-0.7	- 28.0	- 5.9
(c) Federal	0	-4.1	-168.0	-35.4
(d) Total	0	-5.2	-219.0	-96.5
(2) Full-time employment opportunities	0	0	+ 5	+20
3. Plan response to associated evaluation criteria				
a. Acceptability by pollution control authorities	No	Presently - yes Near future - no	Probably	Yes
b. Likelihood of public acceptance	Fair	Good	Good	Poor
c. Reliability				
(1) Wet-weather	Low	Low	Moderate	Moderate
(2) Dry-weather	Low	High	High	High
d. Disruptive effects	Low	Low	Low	Moderate
e. Site availability	—	Fair	Poor	Fair
f. Uncertainties	—	—	—	—

Table C-10
(Cont'd)
ificant Impacts of Alternative Omaha-Missouri River Combined Sewer Plans

abilitate ent System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
.02	1.04	1.48	1.78	1.72	2.12
-0.4	- 23.1	-55.2	- 52.5	- 55.7	- 47.8
-0.7	- 28.0	- 5.9	- 12.1	- 10.0	- 15.8
-4.1	-168.0	-35.4	- 72.4	- 60.2	- 95.0
-5.2	-219.0	-96.5	-137.0	-125.9	-158.6
0	+ 5	+20	+ 23	+ 23	+ 19
tly - yes ture - no	Probably	Yes	Yes	Yes	Yes
Good	Good	Poor	Fair - opposition in Iowa.	Fair - opposition in Iowa.	Good
Low	Moderate	Moderate	High	High	High
High	High	High	High	High	High
Low	Low	Moderate	Low	Moderate	Low
Fair	Poor	Fair	Good	Good	Good
—	—	—	Rock quality for deep tunneling. Pressure head to reach north site questionable.	Rock quality for deep tunneling.	Rock quality for deep tunneling and underground storage.

2

Table C-10
(Cont'd)
Plan Description and Significant Impacts of Alternative Omaha-Miss

	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
D. Implementation Responsibility				
1. Procedure	—	City of Omaha requests funding, builds, and operates.	City of Omaha requests funding, builds, and operates.	Same as Alt. 1.
2. Funding				
a. Capital costs	—	Omaha - 12.5% State - 12.5% Federal - 75%	Omaha - 12.5% State - 12.5% Federal - 75%	Same as Alt.1.
b. O&M	—	Omaha - 100%	Omaha - 100%	Omaha - 100%
3. Institutional problems	—	None	None	Agreements with Carter Lake and Iow for reservoir locations probable by Omaha.

Table C-10
(Cont'd)
nd Significant Impacts of Alternative Omaha-Missouri River Combined Sewer Plans

ehabilitate esent System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
of Omaha re- s funding, ls, and operates.	City of Omaha re- quests funding, builds, and operates.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.	Same as Alt. 1.
ha - 12.5% te - 12.5% leral - 75%	Omaha - 12.5% State - 12.5% Federal - 75%	Same as Alt.1.	Same as Alt.1.	Same as Alt.1.	Same as Alt.1.
ha - 100%	Omaha - 100%	Omaha - 100%	Omaha - 100%	Omaha - 100%	Omaha - 100%
None	None	Agreements with Carter Lake and Iowa for reservoir locations probable by Omaha.	Agreement with Iowa for reservoir location probable by Omaha.	Agreements with Carter Lake and Iowa for reservoir locations probable by Omaha.	None

2

133. Alternative 1 partially meets the planning objectives by reducing pollution caused by the combined overflow. With this alternative, minimal and short-term violations to the water quality standards would continue to occur.

134. The remaining four alternatives fully meet the planning objectives.

RELATIONSHIP TO THE FOUR ACCOUNTS

135. National Economic Development (NED). The NED account for the alternative plans is displayed on table C-11.

136. No monetary benefits for the improvement in water quality can be determined. The river is used for recreation and is a source of supply for municipal and industrial purposes. The river is subject to several additional sources of pollution, particularly agricultural runoff which far exceeds other forms of pollution. To place a monetary value on water quality improvement attributable to a reduction of system bypasses and overflows would be purely speculative.

137. Only two benefits could be quantified for use in the NED account. The first was that of saleable rock from tunnel excavation under Alternatives 4A, 4B, and 5A. Alternative 5A also had a large quantity of rock excavated from the underground storage chambers which could be crushed and sold as gravel. A value of $3.50 per ton was used to compute the benefits.

138. The second beneficial impact was the value of unemployed labor that would be used to construct each alternative. Labor costs make up approximately 50 percent of the capital costs. It is

Table C-11

System of Accounts - Missouri River Combined Sewer Overflows

	Footnotes 1/	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
I. National Economic Development					
A. Beneficial Impacts ($ million)					
1. Value of increased output of goods and services.	3, 5, 7, 10	0	0	0	0
2. Value of unemployed labor utilized.	1, 5, 7, 9	0	0.3	11.5	2.4
3. Total		0	0.3	11.5	2.4
B. Adverse Impacts Plan Costs ($ million)					
1. Capital	1,5,7,9	0	5.5	224.0	47.2
2. O&M	3,5,7,9	0	—	6.6	51.7
3. Total		0	5.5	230.6	98.9
C. Net NED Impacts ($ million)		0	- 5.2	- 219.1	- 96.5
II. Environmental Quality					
A. sthetics	2, 5, 8, 9	Localized floating solids and odors. Fishery quality unacceptable.	Floating solids and odors can occur after heavy rains. Fishery quality unacceptable.	Solids and odors eliminated. Minor deterioration of water quality. Required facilities will have a minimal aesthetic impact.	Improved river es thetics. Storage sites will have ad verse visual impac Possible odor pote tial if aerators malfunction. High proximity to populated areas.
B. Water Quality	2, 5, 8, 9				
1. Surface water					
a. Residual pollutant load to the river (tons/yr)					
(1) BOD		7,400	2,000	1,200	705
(2) SS		7,700	4,000	1,200	885

1/ Footnotes indexed at the end of table C-33.

Table C-11

of Accounts - Missouri River Combined Sewer Overflows

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
0	0	0	7.9	3.6	25.0
0.3	11.5	2.4	4.8	4.0	6.0
0.3	11.5	2.4	12.7	7.6	31.0
5.5	224.0	47.2	96.5	80.2	126.6
—	6.6	51.7	53.2	53.3	63.0
5.5	230.6	98.9	149.7	133.5	189.6
- 5.2	- 219.1	- 96.5	- 137.0	- 125.9	- 158.6
loating solids and dors can occur fter heavy rains. ishery quality nacceptable.	Solids and odors eliminated. Minor deterioration of water quality. Required facilities will have a minimal aesthetic impact.	Improved river esthetics. Storage sites will have adverse visual impacts. Possible odor potential if aerators malfunction. High proximity to populated areas.	Improved river esthetics. Minimal visual impacts. Possible odors if aerators fail. Low proximity to population.	Same as 4A	Improved river esthetics. No visual impact or odor potential.
2,000	1,200	705	705	705	705
4,000	1,200	885	885	885	885

Table C-11
(Cont'd)
System of Accounts - Missouri River Combined Sewer Overflows

	Footnotes 1/	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
b. Meets state water quality standards		No	No	Close	Yes
2. Ground water		No effect	No effect	No effect	No effect with pr per application o engineering princ ples.
C. Land Requirements (acres)	1, 5, 7, 9	0	Minimal	Minimal - all buried storage.	214
D. Air Quality	3, 4, 8, 10	Odors at outfall locations.	No effect	No effect	Possibility of odors if aerators fail.
E. Wildlife Habitat	2, 5, 8, 9	No effect	No effect	No effect	Would remove near bank habitat area for forest and wildlife areas.
III. Social Well-Being					
A. Average Monthly Total Costs Per Customer	2, 5, 7, 9	0	$.02	$1.04	$1.48
B. Average Monthly Energy Cost Per Customer	2, 5, 7, 9	0	—	—	$.67
C. Water-Related Recreation	2, 5, 8, 9			See text - paragraph	
IV. Regional Development					
A. Economic Development					
1. Benefits ($ million)					
(a) Local	1, 5, 7, 9	0	0.3	11.5	2.4
(b) State	1, 5, 7, 9	0	—	—	—
(c) Federal	1, 5, 7,.9	0	—	—	—
(d) Total		0	0.3	11.5	2.4

1/ Footnotes indexed at the end of table C-33.

Table C-11
(Cont'd)
tem of Accounts - Missouri River Combined Sewer Overflows

Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
No	Close	Yes	Yes	Yes	Yes
No effect	No effect	No effect with proper application of engineering principles.	Same as Alt. 2 plus proper tunneling investigation and location required.	Same as Alt. 4A	Same as Alt. 4A
Minimal	Minimal - all buried storage.	214	120	142	Minimal
No effect	No effect	Possibility of odors if aerators fail.	Possibility of odors if aerators fail.	Possibility of odors if aerators fail.	No effect
No effect	No effect	Would remove near-bank habitat areas for forest and wildlife areas.	Agricultural land which supports some small game would be used for storage sites; buffer areas would increase small species habitat.	Same as Alt. 4A	No effect
$.02	$1.04	$1.48	$1.78	$1.72	$2.12
—	—	$.67	$.79	$.76	$1.11
See text - paragraph					
0.3	11.5	2.4	12.7	7.6	31.0
—	—	—	—	—	—
—	—	—	—	—	—
0.3	11.5	2.4	12.7	7.6	31.0

2

Table C-11
(Cont'd)
System of Accounts - Missouri River Combined Sewer Overflows

	Footnotes 1/	Do-Nothing	Rehabilitate Present System	Alt. 1	Alt. 2
2. Costs ($ million)					
(a) Local	3, 5, 7, 9	0	0.7	34.6	57.6
(b) State	1, 5, 7, 9	0	0.7	28.0	5.9
(c) Federal	1, 5, 7, 9	0	4.1	168.0	35.4
(d) Total		0	5.5	230.6	98.9
3. Net benefits ($ million)					
(a) Local	3, 5, 7, 9	0	- 0.4	- 23.1	- 55.2
(b) State	1, 5, 7, 9	0	- 0.7	- 28.0	- 5.9
(c) Federal	1, 5, 7, 9	0	- 4.1	- 168.0	- 35.4
(d) Total		0	- 5.2	- 219.1	- 96.5
B. Local Employment Change	1, 5, 8, 9	0	0	Additional 5 full-time jobs.	Additional 20 full-time jobs.
C. Population Distribution	3, 4, 8, 10	Adverse aesthetic conditions caused by raw and combined sewage discharge may discourage such riverfront projects as Marina City.	Similar to do-nothing except less severe.	Improved river conditions may aid Riverfront projects.	Aerated lagoons [illegible] conflict with Riv[illegible] front development[illegible] light industrial [illegible] areas south of Carter Lake but [illegible] improved river quality would allow for substantial R.D. in area of Carter Lake and Eppley Airfiel[illegible]
D. Affect On Agricultural Development	1, 5, 8, 9	No effect	No effect	No effect	No effect

1/ Footnotes indexed at the end of table C-33.

Table C-11
(Cont'd)
tem of Accounts - Missouri River Combined Sewer Overflows

	Rehabilitate Present System	Alt. 1	Alt. 2	Alt. 4A	Alt. 4B	Alt. 5A
	0.7	34.6	57.6	65.2	63.3	78.8
	0.7	28.0	5.9	12.1	10.0	15.8
	4.1	168.0	35.4	72.4	60.2	95.0
	5.5	230.6	98.9	149.7	133.5	189.6
	- 0.4	- 23.1	- 55.2	- 52.5	- 55.7	- 47.8
	- 0.7	- 28.0	- 5.9	- 12.1	- 10.0	- 15.8
	- 4.1	- 168.0	- 35.4	- 72.4	- 60.2	- 95.0
	- 5.2	- 219.1	- 96.5	- 137.0	- 125.9	- 158.6
	0	Additional 5 full-time jobs.	Additional 20 full-time jobs.	Additional 23 full-time jobs.	Additional 23 full-time jobs.	Additional 19 full-time jobs.
d ch ts	Similar to do-nothing except less severe.	Improved river conditions may aid Riverfront projects.	Aerated lagoons may conflict with Riverfront development's light industrial areas south of Carter Lake but improved river quality would allow for substantial R.D. in area of Carter Lake and Eppley Airfield	Open storage north of C.B. may conflict with R.D's park preservation and recreation area. Improved river quality would allow for substantial R.D. in the area of Carter Lake and Eppley Airfield	Open storage south of C.B. may conflict with R.D's new town and parks and rec. areas. Improved river quality would allow for substantial R.D. in the area of Carter Lake and Eppley Airfield	Improved river quality will aid R.D. projects. Increased capacity will allow substantial industrial development in Carter Lake and Eppley Airfield. Implementation would not adversely affect any R.D. project.
	No effect	No effect	No effect	Loss of 120A	Loss of 75A	No effect

2

assumed that 10 percent of the labor would come from the unemployed ranks; therefore 5 percent of the total capital cost is considered as a beneficial impact.

139. The adverse impacts consist of the present worth costs for implementing the alternative plans.

140. The net NED impacts are the differences between the beneficial and adverse impacts. With the exception of the do-nothing alternative, all of the alternatives have negative net NED impacts. The net impacts range from zero for do-nothing up to minus $219,100,000 for Alternative 1. The equivalent treatment plans, Alternatives 2, 4A, 4B, and 5A, range from minus $96,500,000 to minus $158,600,000. Alternative 2 is the NED plan since it has the most favorable net NED benefit and also meets the planning objectives of the wastewater management study.

141. It should be noted that Alternative 1, which did not meet the planning objectives as well as the other alternatives, is also the highest-cost alternative.

142. Environmental Quality (EQ). All of the alternatives will improve the bankline esthetics of the Missouri River by reducing localized floating solids, discolorations, and odors. Implementation of Alternative 2, 4A, or 4B could cause some adverse esthetic impacts which could be worse than do-nothing. These alternatives provide open storage of the overflows. Alternative 2, because of its several locations, would be hard to isolate from the public and is the least esthetic alternative. Alternatives 4A and 4B are located away from population centers and could be landscaped and screened from public view.

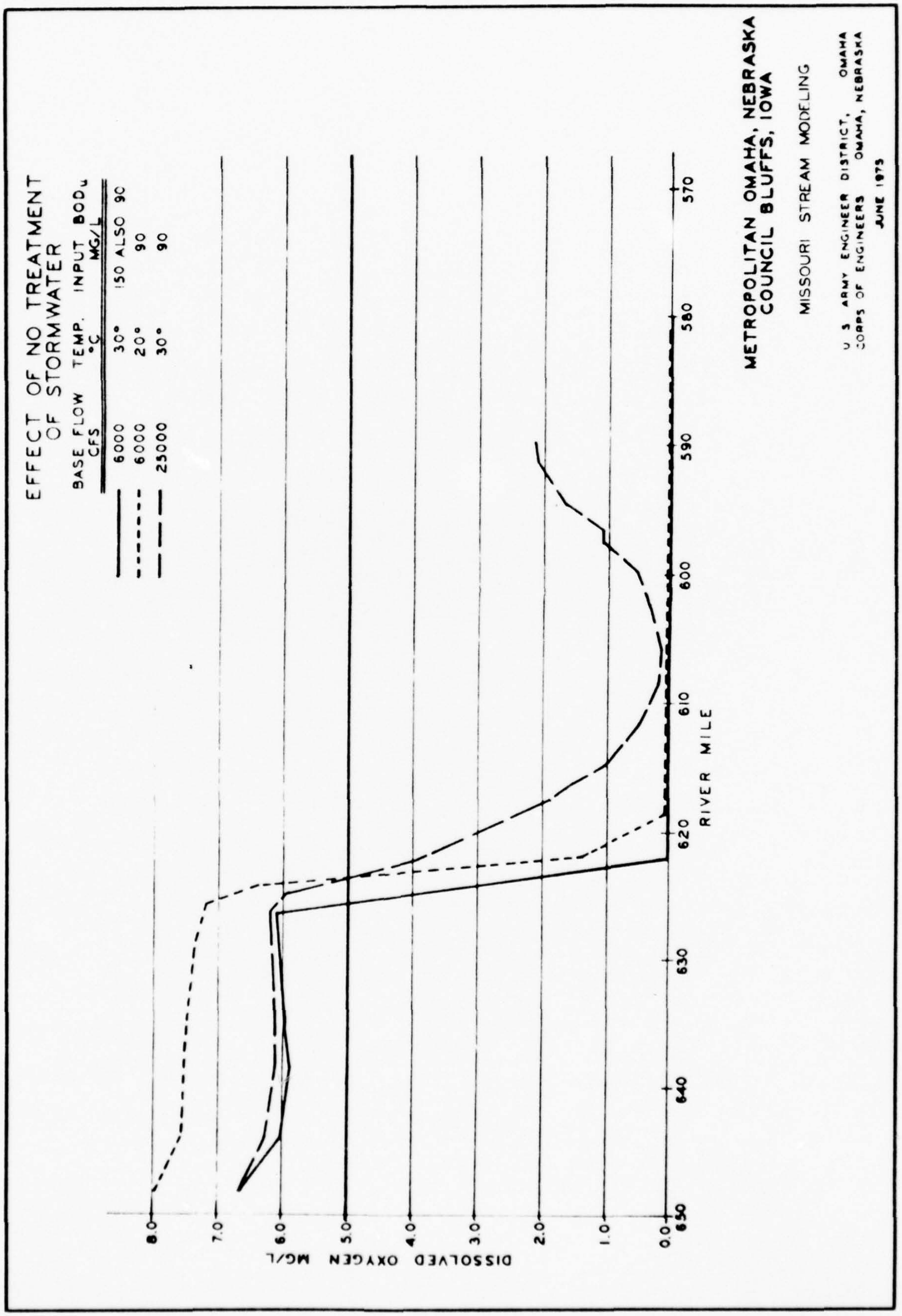
143. The six plans that provide for some form of treatment would result in improvements to Missouri River surface quality. They not only would reduce the BOD and suspended solids load, but also would reduce the loadings of fecal coliform, nutrients, toxic substances, dissolved solids, metals, and chemicals that presently are being discharged into the Missouri River.

144. The effect of do-nothing on the Missouri River is shown on figure C-6. This figure illustrates the need for implementation of an alternative even at the existing average summer flow of 25,000 c.f.s. As future average flows continue to decrease, the situation becomes even more critical.

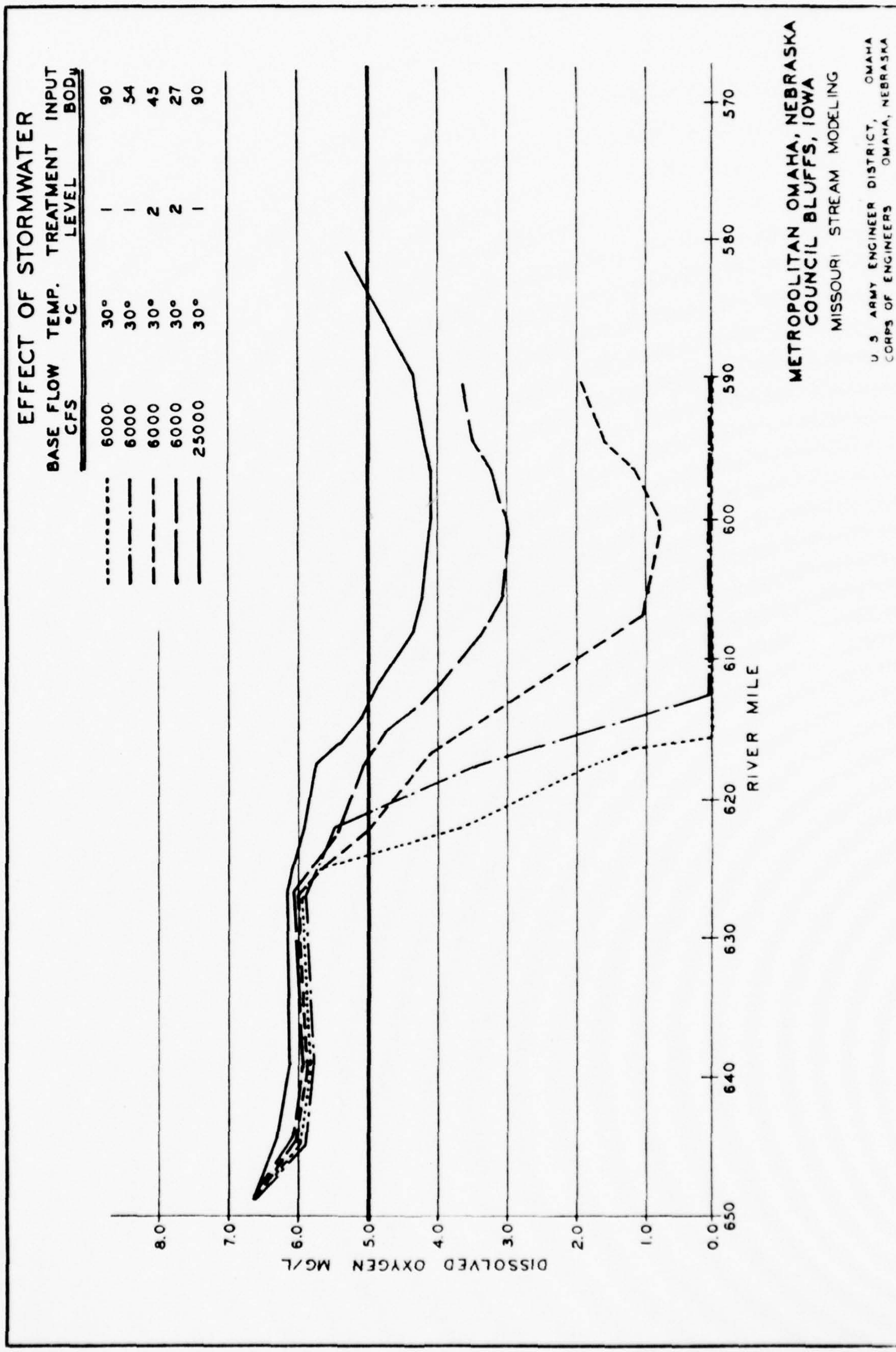
145. It sould be noted that the computed model used to determine the water quality impacts assumes complete mixing of the overflows with the river water. Based on studies of thermal and sediment flumes, this is apparently not the case. In fact, lateral mixing may not occur for several miles downstream. If the pollutants are confined to a narrow band along the river's edge, the water quality effects would be more severe than indicated on figure C-6.

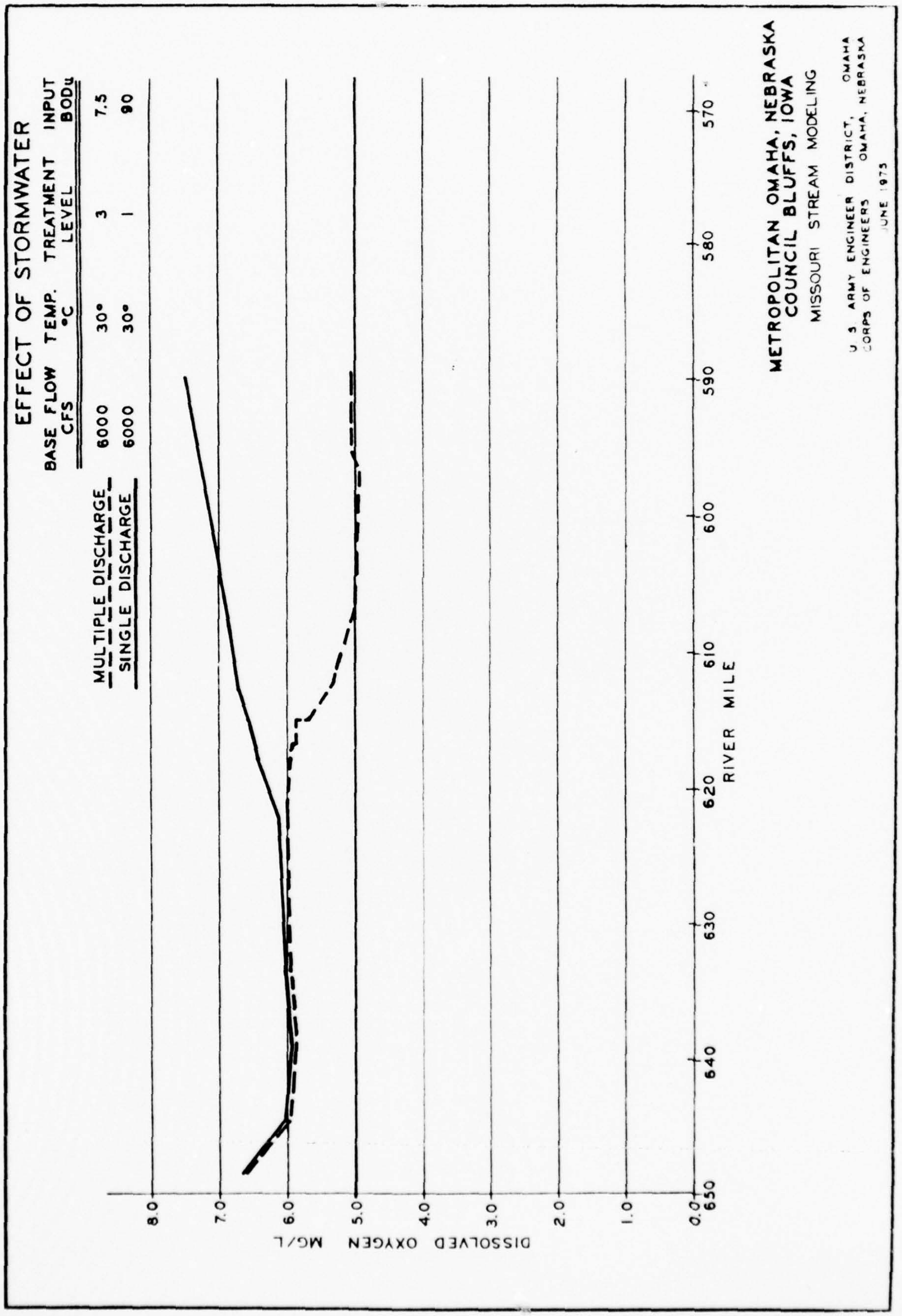
146. The dissolved oxygen impact of Alternative 1 is shown for various flow and treatment levels in figure C-7. This figure shows a slight contravention of the 5.0 mg/l standard at 25,000 c.f.s. and Level 1 (40 percent BOD removal) treatment. As the flows decrease, Level 2 treatment would be required. Alternative 1 is a multiple-discharge alternative with treatment provided at individual overflow points.

147. The dissolved oxygen effects of Alternatives 2, 4A, 4B, and 5A are shown on figure C-8. This figure shows that, even at a



VOLUME VII FIGURE C-6


EFFECT OF STORMWATER
BASE FLOW CFS
TEMP. °C
TREATMENT LEVEL
INPUT BOD5
6000 30° 1 90
6000 30° 1 54
6000 30° 2 45
6000 30° 2 27
25000 30° 1 90
DISSOLVED OXYGEN MG/L
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
RIVER MILE
650
640
630
620
610
600
590
580
570
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
MISSOURI STREAM MODELING
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1973



VOLUME VII FIGURE C-8

river flow of 6,000 c.f.s. and with a minimal amount of treatment, the four alternatives provide satisfactory water quality protection. Alternatives 2, 4A, 4B, and 5A constitute a single-discharge alternative.

148. An analysis of the curves presented on figures C-6, C-7, and C-8 indicates that storage of the overflows is the main element in abating the water quality impacts. The storage component of Alternatives 2, 4A, 4B, and 5A also represents the largest cost item in the alternative. Treatment of the stored overflows is actually a minor component in the water quality protection and in the cost of the alternatives.

149. It is apparent from the above that a multiple-discharge alternative, such as Alternative 1, should be excluded in favor of a single-discharge alternative; i.e., Alternatives 2, 4A, 4B, or 5A.

150. In the formulation of the alternatives, features have been included to minimize any adverse impacts related to ground water contamination. All storage reservoirs, with the exception of the two smallest in Alternative 4B, would be built by fill on top of existing grade. Three feet of clay or impermeable membrane would be installed on the bottom and sides of the reservoirs. The two small reservoirs in Alternative 4B would be excavated below grade. These reservoirs would have 5 feet of clay on the bottom and sides with an underdrain system below the clay.

151. Alternatives 4A, 4B, and 5A include drop shafts, tunnels, and storage chambers mined in the Mississippian rock formation. Exploratory drilling and possibly some tunnel lining would be required

under this alternative to avert any contamination of deep aquifers. The aquifers are not currently used for any major water supply. With the existence of the Missouri River, it is doubtful the aquifers will be used in the forseeable future. It is important, however, to protect all resources so that the opportunities of future generations will not be restricted. In any event, Alternatives 4A, 4B, and 5A include some uncertainty with regard to eventual costs caused by tunnel lining requirements.

152. The plans vary in their effect on land quality. System rehabilitation would require several small sites for construction of the dual facilities. Alternative 1 would require land for storage near the sewer outfalls, but the structures would be buried, thereby minimizing the need for surface land. The top of the structures could be used for recreational purposes such as tennis courts. Alternative 5A has underground storage facilities and would require minimal land. Alternatives 2, 4A, and 4B would have adverse impacts on the environmental quality of the land; from 120 to 214 acres of surface area would be required for the storage facilities. All of the six alternatives would be disruptive to land quality during the construction phase. The majority of this disruption would occur in industrial or agricultural areas.

153. Some of the alternatives could affect the air quality in the form of odors. The do-nothing alternative would create odor problems at the outfall locations whenever dry-weather bypasses occur. The alternatives with open storage, Alternatives 2, 4A, and 4B, could also cause odor problems if the surface aerators were to fail. From May through December the prevailing winds are from the south-southeast. These winds could carry odors from storage locations along the river and south of Council Bluffs into populated areas

of Omaha. Since the storage lagoons would be storing wastewater during the May to December period, the plans calling for storage along the river or south of Council Bluffs should incorporate special features to minimize any potential odor problems. Alternative 4A would be the best open-storage plan from an air quality standpoint. Alternative 5A is the best overall plan from an air quality standpoint because it calls for underground storage.

154. During the winter, the storage reservoirs would be drained and cleaned thereby minimizing winter odor and freezing problems.

155. Alternatives 2, 4A, and 4B would have negligible effects on wildlife habitats at the storage locations. Each site is presently in agricultural use. Vegetated buffer areas around the lagoons would be beneficial to numerous wildlife species, particularly the smaller birds and mammals.

156. The EQ plan is Alternative 5A because it meets the planning objective as well as the other alternatives and minimizes esthetic impacts.

157. Social Well-Being (SWB). The social well-being account includes measurements of the plan characteristics that may affect people directly. These impacts could affect an individual financially or in the way he lives.

158. The beneficial impacts are best expressed as the change that could occur in water-related recreation. With improved Missouri River water quality, water-related recreation should improve. As with the wastewater treatment plans, the improved recreation would be non-body-contact recreation due to the high flow of the river.

Alternatives 2, 4A, 4B, and 5A would improve the river quality the most, although Alternative 1 would probably produce comparable improvements.

159. The cost to an individual customer is the most appropriate way to express the adverse social well-being impacts. The cost of the alternative to the city of Omaha was determined and this was then converted to a per customer per month cost for those customers served by the Omaha sewerage systems. The alternatives range in cost from $.02 per customer per month to $2.12 per customer per month.

160. Average monthly energy costs per month per customer are also shown in table C-11. These are shown for two reasons; first, to indicate that energy costs make up a significant portion of the costs and second, energy conservation should be considered when selecting a plan for implementation. Alternative 2 is the most energy-conserving plan of Alternatives 2, 4A, 4B, and 5A. There is a 10 to 20 percent difference in energy use between Alternative 2 and Alternatives 4A and 4B, the next two most energy-conserving alternatives.

161. Alternative 1 has the lowest local cost and the lowest energy use. This makes Alternative 1 attractive from the local viewpoint. Alternative 1, however, has the highest total present worth of all the alternatives.

162. Regional Development (RD). The regional development account includes a measurement of the distribution of beneficial and adverse impacts among various geographic subdivisions. In the case of the Omaha-Missouri River combined sewer overflow problem, four areas

would be affected, the city of Omaha (local), Pottawattamie County, the State of Nebraska, and the Federal Government.

163. Of the capital costs, the city of Omaha would pay 12.5 percent, the State of Nebraska would pay 12.5 percent, and the Federal Government would pay the remaining 75 percent. All of the operation and maintenance costs would be paid by the city of Omaha.

164. The important item to analyze is the net benefits portion of the account. It depicts the net cost that would be incurred by each governmental level. It is interesting to note that the capital and O&M distribution of costs has a significant effect on the costs for the various governments. The most expensive alternatives are among the lowest cost alternatives at the local level. The four alternatives, 2, 4A, 4B, and 5A, are relatively close to costing the same from a local net benefit standpoint, ranging in local cost from $47,800,000 to $55,700,000. As the local costs go down, the State and Federal costs go up, representing a shift from O&M intensive alternatives to capital intensive alternatives.

165. The population distribution in Omaha could be affected by the alternatives selected. Omaha is currently expanding westward and the riverfront area is slowly being abandoned. Improved river conditions could slow down or even reverse this current trend by removing noticeable pollution.

166. The implementation of Alternative 2, 4A, or 4B could also have adverse effects on the Riverfront Development Program. The effects of Alternative 4A would be minimal. The northernmost storage reservoirs of Alternative 4B are located in riverfront industrial tracts; the most significant impact would be the removal

of 67 acres of industrial land. Alternative 2 requires 212 acres of land within the heart of the riverfront area. The implementation of Alternative 2 would be inconsistent with the riverfront plans to beautify this section of the riverfront area.

167. The small amounts of land removed from agricultural production for storage basins would have negigible effect on the area's agricultural base. Pottawattamie County, Iowa farmland would be used in Alternatives 4A and 4B, which have been opposed by officials of Council Bluffs, Iowa on the basis of potential odor problems.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

168. The most important associated evaluation criteria are acceptability and efficiency.

169. Do-nothing is unacceptable by pollution control authorities and legislators. Rehabilitation of the present system is critical since it insures that all dry-weather flows would receive treatment. The combined sewer overflows would not be treated through rehabilitation, therefore, one of the other five alternatives or some combination must be selected. The other five alternatives are acceptable from a pollution control standpoint.

170. The likelihood of public acceptance is an important criterion. Of the five alternatives, Alternative 1 or 5A is most acceptable to the public. Open storage is opposed, particularly in Council Bluffs.

171. At public meetings, another alternative, sewer separation, was discussed. Although the present worth costs of separation would amount to $539,000,000, separation received as much public support as Alternative 1 or 5A.

172. Although Alternative 2 is the NED alternative, it would encounter the most opposition. Recent efforts to locate a well-managed "bale-fill" disposal site in the same area as one of the storage reservoirs was violently opposed by the public. Alternatives 4A and 4B have received opposition from some officials in Council Bluffs. Council Bluffs has been plagued with odor problems mainly from a meat-packing plant and residents are very odor conscious. Adequate safeguards against odors in the two reservoir locations could be provided. Adjacent land uses are primarily agricultural and industrial.

173. It is likely that the final alternative could be a combination of Alternatives 4B and 5A. Storage reservoirs located in the north portion (Alternative 4B) are located primarily in industrial areas. Buried storage in the south portion (Alternative 5A) of the combined sewer area would reduce adverse esthetic impacts in a densely populated area. Significant quantities of Iowa land would not be required. Costs of this alternative would be more than 4B but less than 5A. In essence, this alternative is similar to 4B except that the large Iowa storage reservoir would be replaced by the buried storage of Alternative 5A. Annex J of the Supporting Technical Reports Appendix discusses this alternative.

174. Alternatives 2, 4A, 4B, and 5A are equally effective in fulfilling the planning objectives. Alternative 1 is slightly less effective. The criterion of efficiency must, however, be considered in light of the large investments required for any of the alternatives.

175. The conclusions of this portion of the urban study pertinent to future planning efforts are that storage appears to be the most

important component in abating pollution from the overflows and that storage of a 1-year design storm appears more than adequate to protect the dissolved oxygen content of the Missouri River.

176. It is apparent that additional studies should be performed to analyze the feasibility of reducing the capacity of the urban study alternatives or perhaps of reevaluating earlier alternatives that were rejected because they did not meet an acceptable level of the planning objectives. The additional studies should be oriented toward determining what level of abatement of the overflows is necessary so that the residual waste load would not overload the assimilation capacity of the Missouri River. These studies should include sampling of the overflows, sampling of instream effects, more extensive Missouri River modeling, and treatability of the overflow pollutants. These studies are necessary to determine the most efficient sizing of any collection, storage, or treatment facilities. A draft work plan for these additional studies has been presented to the Metropolitan Area Planning Agency for incorporation as part of future Sec. 208 planning activities.

PAPILLION CREEK COMBINED SEWER OVERFLOWS

PLAN DESCRIPTION

177. Three alternatives for the abatement of the combined sewer overflows to Little Papillion Creek from the Benson-Westside and Saddle Creek service areas were selected for final evaluation. The alternatives were sewer separation, storage with treatment before discharge, and storage with conveyance to the Papillion Creek Sewage Treatment Plant for treatment. The alternatives are described and evaluated in table C-12.

Table C-12
Evaluation of Papillion Creek Combined Sewer Overflow Alternatives

	Footnotes 1/	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
A. Plan Description		Allow the overflows to continue.	Separate the sewers into sanitary and storm sewers.	Capture overflows store them in buried concrete basins, provide the equivalent to primary treatment, and discharge to Little Papillion Creek.	Capture overflows, store them in buried concrete basins, release at a controlled rate to interceptor, provide treatment equivalent to secondary treatment to most of the overflows and primary to the high volume overflows at the Papillion Creek plant, and discharge to the Missouri River.
B. Significant Impacts		Pollution of Little and Big Papillion Creeks. Raw sewage flows in parks and near residential areas.	All sanitary wastewater receives treatment. Stormwater flow continues to pollute Little and Big Papillion Creeks.	Removes 40% BOD, 70% SS, all of fecal coliforms, and some of the other pollutants from Little and Big Papillion Creeks due to combined sewer overflows.	Removes all of the combined sewer flows from Little and Big Papillion Creeks up to the design storm.
C. Plan Evaluation					
1. Contributions to planning objectives		None	Removes sanitary flows from Little Papillion Creek.	Provides treatment of combined sewer overflows adequate to maintain D.O. levels.	Provides treatment of combined sewer overflows adequate to maintain D.O. levels.
2. Relationship to four National accounts					
a. NED ($ million)	3, 5, 7, 9				
(1) Beneficial impacts		None	7.0	2.5	4.2
(2) Adverse impacts		None	140.4	55.0	86.6
(3) Net impact		None	-132.6	-52.5	-82.4

1/ Footnotes indexed at the end of table C-33.

Table C-12
(Cont'd)
Evaluation of Papillion Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat
b. EQ	2, 5, 8, 9				
(1) Beneficial impacts		None	Slight increase in species diversity of aquatic life. Reduction in disease potential due to human wastes.	Improvement in species, diversity of aquatic life. Disease potential greatly reduced.	Improvement in species, diversity of aquatic life. Disease potential greatly reduced.
(2) Adverse impacts		Low aquatic life species diversity. Disease potential high due to human fecal contamination.	Disruption of residential, park, and commercial areas during construction.	Requires land for storage (449 ac-ft) and treatment facilities. Disruption of residential, park, and commercial areas during construction.	Requires land for storage (1,273 ac-ft) and treatment facilities. Disruption of residential, park, and commercial areas during construction.
(3) Pollutant loads (tons/year)				Level 1 / Level 2	Level 1 / Level 2
(a) BOD		870	330	520 / 290	520 / 290
(b) SS		2,170	3,190	650 / 220	650 / 220
c. SWB					
(1) Beneficial impacts	2, 5, 8, 9	None	Papillion Creek and Elmwood Park would be safer for recreational activities.	Same as separation.	Same as separation.
(2) Adverse impacts Cost/month-customer	2, 5, 7, 9	None	$.50	$.24	$.36

1/ **Footnotes indexed at the end of table C-33.**

Table C-12
(Cont'd)
Evaluation of Papillion Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat
d. RD ($ Million)					
(1) Local costs	3, 5, 7, 9	None	17.6	8.3	12.6
(2) State costs	1, 5, 7, 9	None	17.6	6.7	10.6
(3) Federal costs	1, 5, 7, 9	None	105.6	40.0	63.4
3. Plan response to associated evaluation criteria					
a. Acceptability		No	No-pollution still will occur due to stormwater.	Yes	Yes
b. Completeness		No	Still allows major pollution due to stormwater.	Still allows minor pollution due to low strength effluent.	Yes-removes all pollution coming from combined sewer areas.
D. Implementation Responsibility		None	City of Omaha initiates funding requests for construction. Once built, city of Omaha operates and maintains.	City of Omaha (see separation).	City of Omaha (see separation).

1/ Footnotes indexed at the end of table C-33.

CONTRIBUTION TO PLANNING OBJECTIVES

178. The planning objective for the Little Papillion Creek overflows was to abate pollution caused by the overflows to the extent necessary to maintain water quality standards.

179. From a pollution control standpoint, the upsystem storage and conveyance alternative is the best. Most of the overflow would receive secondary treatment with the rest receiving the equivalent to primaty treatment. The effluent would then be discharged to the Missouri River. Upsystem storage and treatment provides only a slightly lower level of treatment, but the effluent would be discharged to Little Papillion Creek which has a low assimilative capacity. The effluent would have more of an impact on Little and Big Papillion Creeks than it would on the Missouri River. State water quality standards for dissolved oxygen could be maintained, however, with this alternative. Separation would only remove the sanitary flow, but this would be an improvement because most of the fecal coliform contamination would be removed.

RELATIONSHIP TO FOUR ACCOUNTS

180. National Economic Development (NED). Like the other wastewater management plans, no monetary benefits were computed for the improvement in water quality. The beneficial impacts shown on table C-12 would result from the use of unemployed labor during construction.

181. It is possible that an increase in recreation along the Papillion Creek flood plain would result from reducing pollution caused by the overflows. This potential increase is included in the social well-being account.

182. The adverse NED impact of the alternatives is the project cost. Upsystem storage and treatment has a present worth cost of $52,400,000, upsystem storage and conveyance $86,600,000, and separation of $140,400,000. These costs include the capital and O&M costs for Growth Concept A for the next 50 years. The separation cost is based on a cost of $27,000 per acre. In 1970 approximately 100 acres of combined sewer were separated in the eastern part of Omaha at a cost of $18,000 per acre. Projects performed elsewhere in 1970 showed a separation cost of about $20,000 per acre. The $27,000 figure represents the increase in construction costs from 1970 to 1975.

183. Based on net NED benefits and on compliance with the planning objectives, the NED plan is upsystem storage and treatment.

184. Environmental Quality (EQ). Environmental quality would improve with the amount of treatment provided. The order of improvement is, from least to most, separation, upsystem storage and treatment, and upsystem storage and conveyance. The level of treatment provided by upsystem storage and treatment could be improved by adding microstraining to the treatment process at an additional present worth cost of $13,200,000. The improvement in the environmental quality may not warrant such an expenditure.

185. Separation, upsystem storage and treatment, and upsystem storage and conveyance would all have considerable disruptive effects to the environment during construction. The social well-being of the people in the construction areas would also be disrupted during construction. Excavation for sewers would be required in several neighborhoods in the combined sewer area. The separation alternative would be the most disruptive because

it would involve excavation and sewer hookups at residences. The other two alternatives involve mainly trunk sewers.

186. The pollutant loadings that would be discharged to Little Papillion Creek or the Missouri River are presented in table C-12. Separation would result in the lowest BOD loading and the two treatment alternatives would result in the lowest suspended solids loading. The suspended solids loading would increase under the separation alternative since the "first flush" would not be carried in the sewers to a treatment facility as it would under the other two alternatives.

187. Because of cost factors, it is valid to compare the environmental protection of upsystem storage and treatment using Level 2 treatment (present worth cost $65,600,000) with Level 1 treatment for the conveyance alternative (present worth cost $86,600,000). Up to the design storm, the former alternative would provide 70 percent BOD removal and 90 percent suspended solids removal. Flows in excess of the design storm could be routed through the facility at a reduced treatment rate. Under the latter alternative, storm flows in excess of the design capacity of the Papillion Creek sewage treatment plant would be routed to a stormwater treatment facility with removal rates of 40 percent BOD and 70 percent suspended solids. Flows in excess of the design storm would be bypassed directly to the Little Papillion Creek.

188. Although table C-12 indicates approximately an equal amount of pollution removals under any one of the three alternatives, the upsystem treatment alternative would produce better overall removals since the majority of rainfall occurs at less than the 1-year event.

For the above reasons, the upsystem storage and treatment alternative with Level 2 treatment is the EQ plan.

189. Social Well-Being (SWB). A reduction in pollution caused by the overflows would greatly improve the esthetic conditions of downstream reaches. In portions of the downstream areas, residential land uses are very close to the creek. Odor problems have been the basis of numerous citizen complaints. One of the overflow points discharges into the creek that runs through Elmwood Park, one of Omaha's most heavily used recreational facilities. Concern of potential health hazards has been raised by citizens and local officials.

190. All of the alternatives would contribute in an equal manner in noticeably improving the above conditions.

191. Adverse impacts would occur during the construction phase and in financing the alternatives. Sewer separation would be the most disruptive of normal activities. The other two alternatives would cause some disruption primarily through park and recreational facilities. The major amount of construction would occur immediately adjacent to the creek and, therefore, should cause minimal impacts.

192. The costs per customer per month are not significant enough by themselves to cause adverse social effects.

193. Regional Development (RD). The cost allocation for the Papillion Creek overflow alternatives is identical to the other wastewater management plans.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

194. Important associated evaluation criteria are the acceptability and completeness of the plans. The only alternative that is not acceptable is the do-nothing alternative, primarily because of the publicly noticeable adverse esthetic and health conditions.

195. In terms of completeness, sewer separation would still allow pollution due to separate stormwater runoff. Up to the design storm, the conveyance alternative would remove more potential pollutants from the creek than would the upsystem treatment alternative. For storms exceeding the design storm event, the completeness is reversed.

INDIAN CREEK COMBINED SEWER OVERFLOWS

PLAN DESCRIPTION

196. The three alternative solutions to the Indian Creek combined sewer overflow problem are separation of the sewers, upsystem storage and treatment before discharge, and upsystem storage and conveyance to the Mosquito Creek sewage treatment plant south of Council Bluffs for treatment. These alternatives and their evaluation are summarized in table C-13. The alternatives are identical in concept to the Papillion Creek overflow alternatives.

CONTRIBUTION TO PLANNING OBJECTIVES

197. The planning objectives for the Indian Creek overflows are identical to those for the Papillion Creek overflows.

RELATIONSHIP TO THE FOUR ACCOUNTS

198. National Economic Development (NED). Beneficial NED impacts occur from the use of unemployed labor during construction. Five percent of the construction costs were allocated to this benefit.

Table C-13
Evaluation of Indian Creek Combined Sewer Overflow Alternatives

	Footnotes 1/	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
A. Plan Description		Allow the overflows to continue.	Separate the sewers into sanitary and storm sewers.	Capture overflows store them in a buried concrete basin, provide the equivalent to primary treatment, and discharge to Indian Creek.	Capture overflows store them in a buried concrete basin, release at a controlled rate to the main trunk sewer to the Council Bluffs-Mosquito Creek plant for secondary treatment of most of the wastewater and the equivalent to primary treatment to the rest, and discharge to the Missouri River.
B. Significant Impacts		Pollution of Indian Creek south of 28th Avenue, primarily an open space area and cropland area.	All sanitary wastewater receives treatment. Stormwater flow continues to pollute Indian Creek at various discharge points above 28th Avenue.	Removes 40%, BOD, 70% SS, all of fecal coliforms and some of the other pollutants from Indian Creek due to combined sewer overflows.	Removes all of the combined sewer flows from Indian Creek up to the design storm.
C. Plan Evaluation					
1. Contributions to planning objectives		None	Removes sanitary flows from Indian Creek.	Provides treatment of Indian Creek combined sewer overflows.	Provides treatment of Indian Creek combined sewer overflows.
2. Relationship to four National accounts					
a. NED ($ million)	3, 5, 7, 9				
(1) Beneficial impacts		None	0.2	0.4	0.7
(2) Adverse impacts		None	3.4	9.0	13.3
(3) Net impacts		None	-3.2	-8.6	-12.6

1/ Footnotes indexed at the end of table C-33.

Table C-13
(Cont'd)
Evaluation of Indian Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
b. EQ	2, 5, 8, 9				
(1) Beneficial impacts		None	Indian Creek water quality improved below 28th Avenue since sanitary pollutants are removed.	Indian Creek water quality improved below 28th Avenue. More diverse species of aquatic life should exist.	Indian Creek water quality improved below 28th Avenue. More diverse species of aquatic life should exist.
(2) Adverse impacts		Health hazard to wildlife and humans due to fecal contamination.	Indian Creek water quality above 28th Avenue degraded due to stormwater. This section is primarily a concrete-lined channel though and there is no access to most of it. Disruption of residential, park, and commercial areas during construction	Requires land for storage (376 ac-ft) and treatment facilities.	Requires land for storage (1,275 ac-ft) and treatment facilities.
(3) Pollutant loadings (tons/year)					
(a) BOD		350	90	210	210
(b) SS		870	1,020	260	260
c. SWB					
(1) Beneficial impacts	2, 5, 8, 9	None	Indian Creek would be safer from a health standpoint.	Same as separation.	Same as separation.
(2) Adverse impacts (1995) (cost/customer -month)	2, 5, 7, 9	None	$.19	$.85	$1.06

1/ **Footnotes indexed at the end of table C-33.**

Table C-13
(Cont'd)
Evaluation of Indian Creek Combined Sewer Overflow Alternatives

	Footnotes[1/]	Do-Nothing	Separation	Up-Treat-Disch.	Up-Conv.-Treat.
d. RD ($ million)					
(1) Local costs	3, 5, 7, 9	None	.4	2.0	2.8
(2) State costs	1, 5, 7, 9	None	.4	0.4	0.7
(3) Federal costs	1, 5, 7, 9	None	2.6	6.6	9.8
3. Plan response to associated criteria					
a. Acceptability		No	Yes	Yes	Yes
b. Effectiveness		No	Not as much as the treatment alternatives but is adequate for the situation.	Yes	Yes
D. Implementation Responsibility		None	City of Council Bluffs initiates funding request for construction. It then operates and maintains the system.	City of Council Bluffs (see separation)	City of Council Bluffs (see separation)

1/ **Footnotes indexed at the end of table C-33.**

199. Adverse NED impacts consist of the project costs. The alternatives range in cost from $3,400,000 for separation to $13,300,000 for conveyance. Upsystem treatment has a present worth cost of $9,000,000. Level 2 stormwater treatment can be added to this alternative at a present worth cost of $1,000,000, making it cheaper than the conveyance alternative.

200. The costs of separation were obtained from a detailed sewer separation study developed for the city of Council Bluffs in 1967. The costs contained in that study were updated to 1975 costs.

201. Because the separation costs are appreciably lower than the other two alternatives and because separation would provide satisfactory fulfillment of the planning objectives, separation is the NED plan for the Indian Creek overflows.

202. Environmental Quality (EQ). The environmental quality of the Indian Creek basin in the area above and below the overflow point, near 28th Avenue, would be affected. The main effect would be the removal of the health hazard that exists due to the sanitary portions of the overflows. The channel is accessible to children and there is a high possibility that contact with the Indian Creek flow during or shortly after a storm could endanger the health of these children. The Indian Creek channel is only a few hundred feet away from a large trailer court south of the overflow point and there is also some residential development near Lake Manawa.

203. The impact of the stormwater flows is not as significant as the sanitary flows. Separation would result in the addition of several stormwater discharge points north of the present overflow point. Portions of the channel above 28th Avenue are not accessible

to the public. Also, the normal flow of Indian Creek is very low so there are almost no aquatic species present. Land use south of the overflow is primarily industrial and agricultural. This would indicate that there would be little benefit to treating the stormwater portion of the overflows. In a practical sense, Indian Creek functions mainly as a stormwater drainage ditch.

204. Separation would have disruptive effects within the combined sewer area during construction. The environmental quality and social well-being of local residents would be affected by sewer construction. Because sewer hookups could be required at most residences in the area, construction could occur in the front yards of many homes and places of business. The upsystem storage alternatives require construction that would be disruptive to the environment, but construction would be in an area away from residences and places of business.

205. Pollutant loadings for each of the alternatives are presented in table C-13. Separation would result in the lowest BOD loading to Indian Creek or the Missouri River and the two treatment alternatives would result in the lowest suspended solids loading. Separation would result in even higher suspended solids loading than the do-nothing alternative because the "first flush" would not go to the treatment plant as it would in a combined sewer system.

206. The residual pollutant loadings for the two treatment alternatives assume Level 1 stormwater treatment (40 percent BOD removal; 70 percent suspended solids removal). As indicated in the NED account, Level 2 stormwater treatment (70 percent BOD removal; 90 percent suspended solids removal) can be cost-effectively applied to the upsystem treatment alternative. This would make the residual

BOD and suspended solids loading equal to 105 and 87 tons per year, respectively, for the upsystem treatment alternative.

207. The EQ plan is upsystem storage and treatment with Level 2 treatment for the same reasons discussed in the Little Papillion Creek combined sewer overflow section.

208. Social Well-Being (SWB). The social well-being impacts are the improvement of the health conditions for those individuals near the creek and the cost of the alternatives to the citizens of Council Bluffs. The estimated average monthly costs (1995) would range from $.19 to $1.06 per month per customer.

209. Because the land uses downstream from the Indian Creek overflow point are primarily industrial or agricultural, the esthetic impacts of the overflows are less noticeable than in the Papillion Creek basin.

210. Regional Development (RD). The regional development impacts are also presented in table C-13. The costs of the alternatives would be split among the city of Council Bluffs, the State of Iowa, and the Federal Government, with the capital costs split 20, 5, and 75 percent, respectively. The O&M costs, very low in general, would be incurred by the city of Council Bluffs.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

211. Important associated evaluation criteria are plan acceptability and effectiveness. Sewer separation is the most acceptable alternative based largely on cost factors. Because of the wide variation in costs and the lack of appreciable benefits, it is doubtful that the Environmental Protection Agency would view the other alternatives as being cost-effective.

212. Sewer separation would also serve multi-purpose functions. The current sewer system is subject to frequent cave-ins and is partially responsible for temporary street flooding and basement back-ups during storm events. Separation would help eliminate these problems.

SEPARATE STORMWATER RUNOFF

PLAN DESCRIPTION

213. There is one final structural, separate stormwater treatment alternative to evaluate; upsystem storage and treatment before discharge to the receiving stream. The plan description and evaluation are summarized in table C-14. The impacts for a do-nothing alternative are also given for comparision with the treatment alternative.

CONTRIBUTION TO PLANNING OBJECTIVES

214. The planning objective for urban stormwater runoff was to provide enough pollution reduction to maintain State water quality standards during the runoff event.

215. The impacts for the do-nothing alternative on water quality was modeled for the Papillion Creek system and violations of the water quality standards for dissolved oxygen in the lower reaches were found. In addition, the tremendously higher loads of pollutants such as suspended and floating solids, fecal coliforms, and other constituents are almost certain to cause water quality violations.

216. The upstream storage and treatment alternative with Level 1 stormwater treatment was found to be capable of maintaining the

Table C-14
Evaluation of the Urban Stormwater Treatment Alternatives

	Footnotes[1/]	Do-Nothing	Upstream Storage and Treatment
A. Plan Description		Continue to allow the stormwater to discharge into area streams without treatment.	Intercept the stormwater at the discharge points, store it in concrete or earthen basins, release the flows at a controlled rate for the equivalent to primary treatment at facilities adjacent to the basins, and discharge to the stream. (This applies to separate stormwater systems only.) (1-yr. storm, Level 1 treatment).
B. Significant Impacts		Pollution during and after storms of the streams near and in urban areas. Significant DO drops during and following storms. Recreational use of the streams is downgraded.	Removal of portions of the stormwater pollutants: BOD - 40%, SS - 70%, coliforms and bacteria, and many other harmful constituents. Meeting of State water quality standards.
C. Plan Evaluation			
1. Contributions to Planning Objectives		None	Provides reduction in stormwater runoff so that State water quality standards can be met. (Level 1 treatment of stormwater.)
2. Relationship to Four National Accounts			
a. NED ($ million)	3, 5, 7, 9		
(1) Beneficial Impacts		-	5.0
(2) Adverse Impacts		-	107.8
(3) Net Impact		-	-102.8

1/ Footnotes indexed at the end of table C-33.

Table C-14
(Cont'd)
Evaluation of the Urban Stormwater Treatment Alternatives

	Footnotes 1/	Do-Nothing	Upstream Storage and Treatment
b. EQ			
(1) Pollutant Loadings Attributable to Stormwater (1995) (tons/year)	2, 5, 8, 9		
(a) BOD		3,060	1,840
(b) SS		25,070	7,520
(2) Minimum DO Concentrations (mg/l)	1, 5, 8, 9		
(a) Little Papillion		3	6
(b) Big Papillion and Papillion		0	6
(3) Land required for Stormwater Treatment Facilities (acres)		0	2,271
(4) Construction Disruption	1, 6, 8, 9	No	Yes - for storage basin and interceptor construction.
(5) Fish and Wildlife	2, 5, 8, 9	Only pollution tolerant species	Greater diversity of species present.
c. SWB			
(1) Recreation	2, 5, 8, 9	Little use of the area waters for recreational purposes.	Improved water quality of area waters should encourage more water-related recreation.
(2) Consumer Costs (cost/customer-month)	2, 5, 7, 9	0	$.73
d. RD ($ million)			
(1) Local Cost	3, 5, 7, 9	0	20.5
(2) State Cost	1, 5, 7, 9	0	11.4 Nebraska .4 Iowa
(3) Federal Cost	1, 5, 7, 9	0	75.5

1/ Footnotes indexed at the end of table C-33.

Table C-14
(Cont'd)
Evaluation of the Urban Stormwater Treatment Alternatives

	Footnotes[1/]	Do-Nothing	Upstream Storage and Treatment
3. Plan Response to Associated Evaluation Criteria			
a. Effectiveness		No	Yes - can go to a higher level of treatment if necessary for an additional 31.3 million dollars.
b. Certainty		-	PL 92-50 requires stormwater treatment by 1983. Economics may be a problem and this requirement may be relaxed (See Federal Register, Vol. 40, No. 103, May 28, 1975.)
D. Implementation Responsibilities			
1. Initiation of Plan		-	Municipalities in which the stormwater treatment system is to be constructed.
2. Funding of the Plan			
a. Capital		-	Nebraska / Iowa Local 12.5% / 20% State 12.5% / 5% Federal 75% / 75%
b. O&M		-	Local (Municipalities)
3. Funding Capabilities		-	Federal and State funding is not keeping up with the needs. Local funding - See paragraphs 167 through 171.

1/ Footnotes indexed at the end of table C-33.

stream oxygen standard of 5.0 mg/l. A significant reduction in other pollutants could also be anticipated.

RELATIONSHIP TO THE FOUR ACCOUNTS

217. National Economic Development (NED). The NED impacts given in table C-14 are mainly the adverse impacts because it is difficult to put a monetary value on the beneficial impacts, mainly improved water quality. The beneficial impact shown represents the value of unemployed labor used to construct the facilities. The value presented is 5 percent of the capital cost of the alternative. The adverse impact is the present worth cost to implement the plan until 2020. Since upsystem storage and treatment is the only alternative left that meets the planning objectives, it is the NED plan.

218. For additional pollutant removal, Level 2 stormwater treatment can be added at a present worth cost of $31,300,000. This indicates that storage is the major cost variable in the alternative.

219. Environmental Quality (EQ). Modeling of the Little and Big Papillion Creeks to show the effects of stormwater and its treatment on water quality indicates significant impacts on the dissolved oxygen concentrations of the streams. The DO would improve from 3 mg/l to 6 mg/l on the Little Papillion Creek and from 0 to 6 mg/l on the Big Papillion and Papillion Creeks with Level 1 stormwater treatment. This improvement should result in a greater diversity of wildlife associated with the streams.

220. The water quality impacts are most noticeable in the lower reaches of the Papillion Creek system. Figure C-9 shows the effect of peak runoff pollution loadings for the 1-year storm. Figure C-10 shows the impact of the upstream storage-treatment

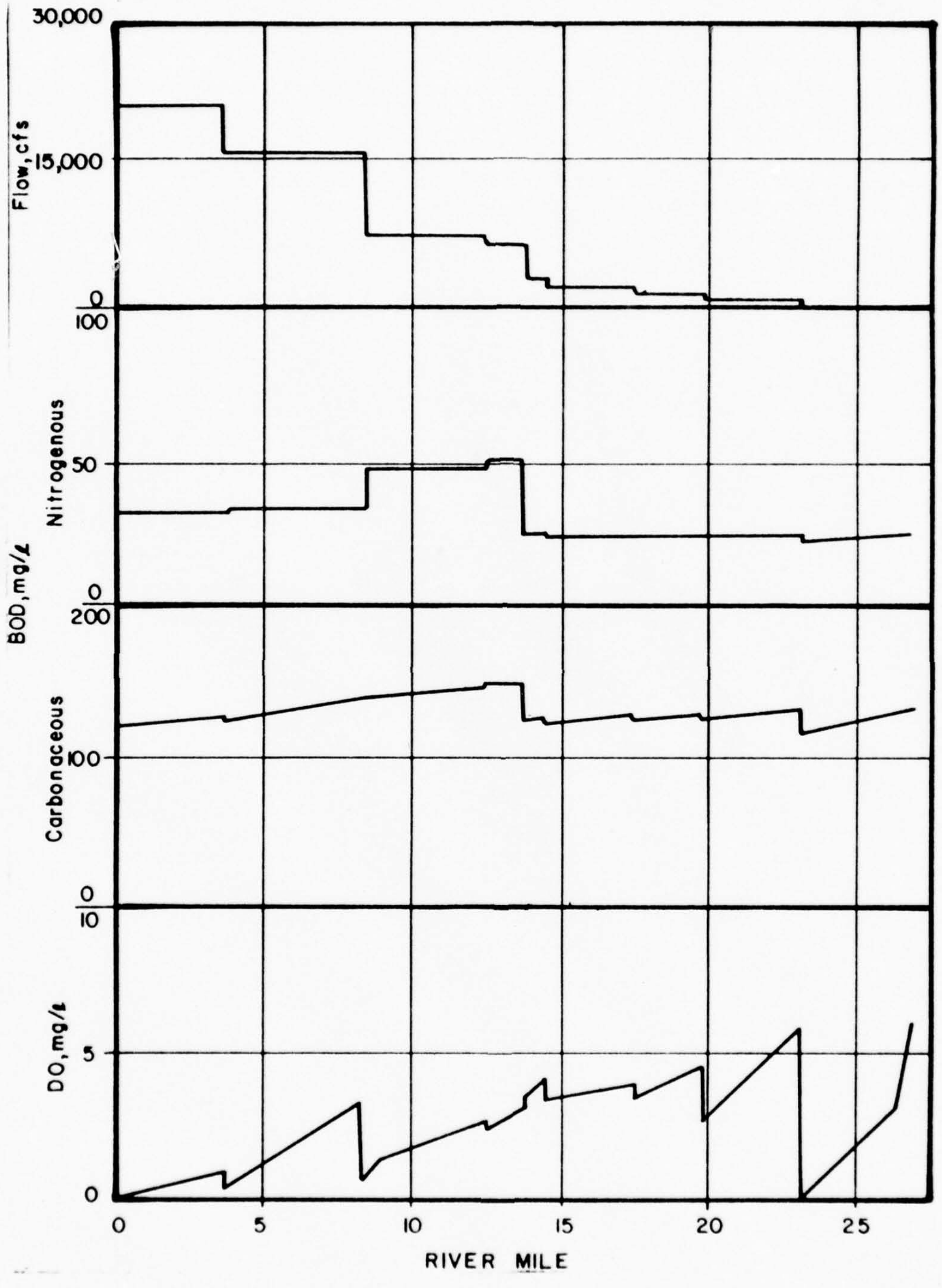
alternative for the same storm. In both figures, river mile 0 represents the junction of the Papillion Creek with the Missouri River.

221. The other streams subject to urban runoff were not modeled. However, the physical characteristics of most streams are similar to Papillion Creek and, therefore, are assumed to exhibit similar effects.

222. Perhaps even more significant are the effects of stormwater runoff discharges from the Papillion Creek system on the Missouri River. Figure C-11 shows the effects of wastewater effluents on the river and also the effects of an untreated Papillion Creek stormwater discharge as it enters and travels down the Missouri River.

223. Figure C-12 illustrates the combined effects of the wastewater effluents, a single discharge from the Omaha Missouri River overflows and Level 1 stormwater treatment of Papillion Creek urban runoff on the Missouri River. Options A, B, and C relate only to the 6,000 c.f.s. base flow and 25° C. temperature conditions. Figure C-12 shows that under high flow, high temperature conditions, stormwater treatment Level 1 is quite effective in maintaining dissolved oxygen standards in the Missouri River. At low flow, high temperature conditions, however, a minimum of Level 2 treatment would be required. Fortunately, the low flow, high temperature conditions are not projected to occur until after the year 2000.

224. It cannot be determined what improvement will occur in the Papillion Creek ecosystem by implementation of the alternatives. The stream, because of its physical and hydrologic conditions,



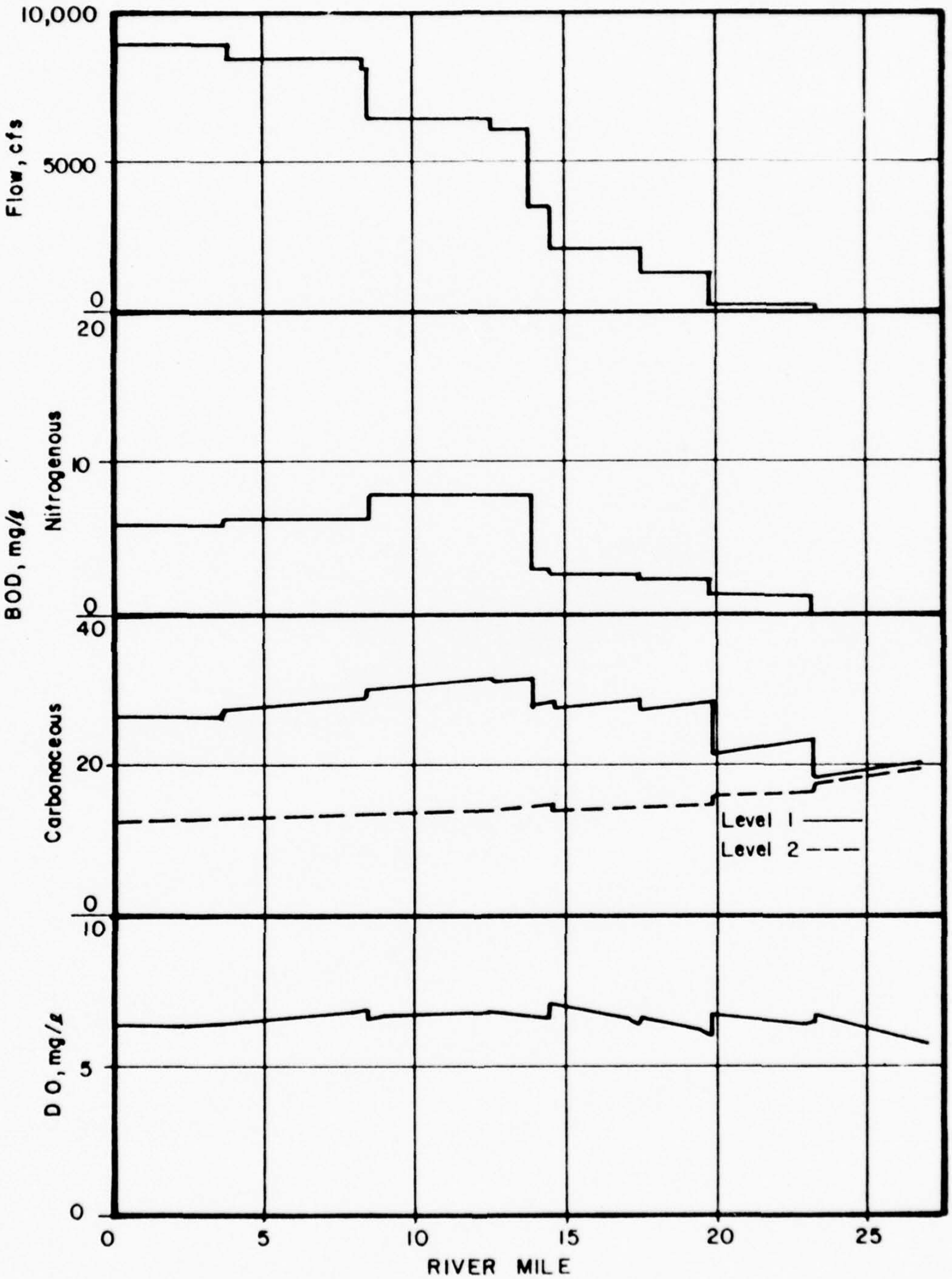
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

BIG PAPILLION CREEK
RIVER MILES VS
QUALITY AND FLOW
NO TREATMEMT

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME VII FIGURE C-9

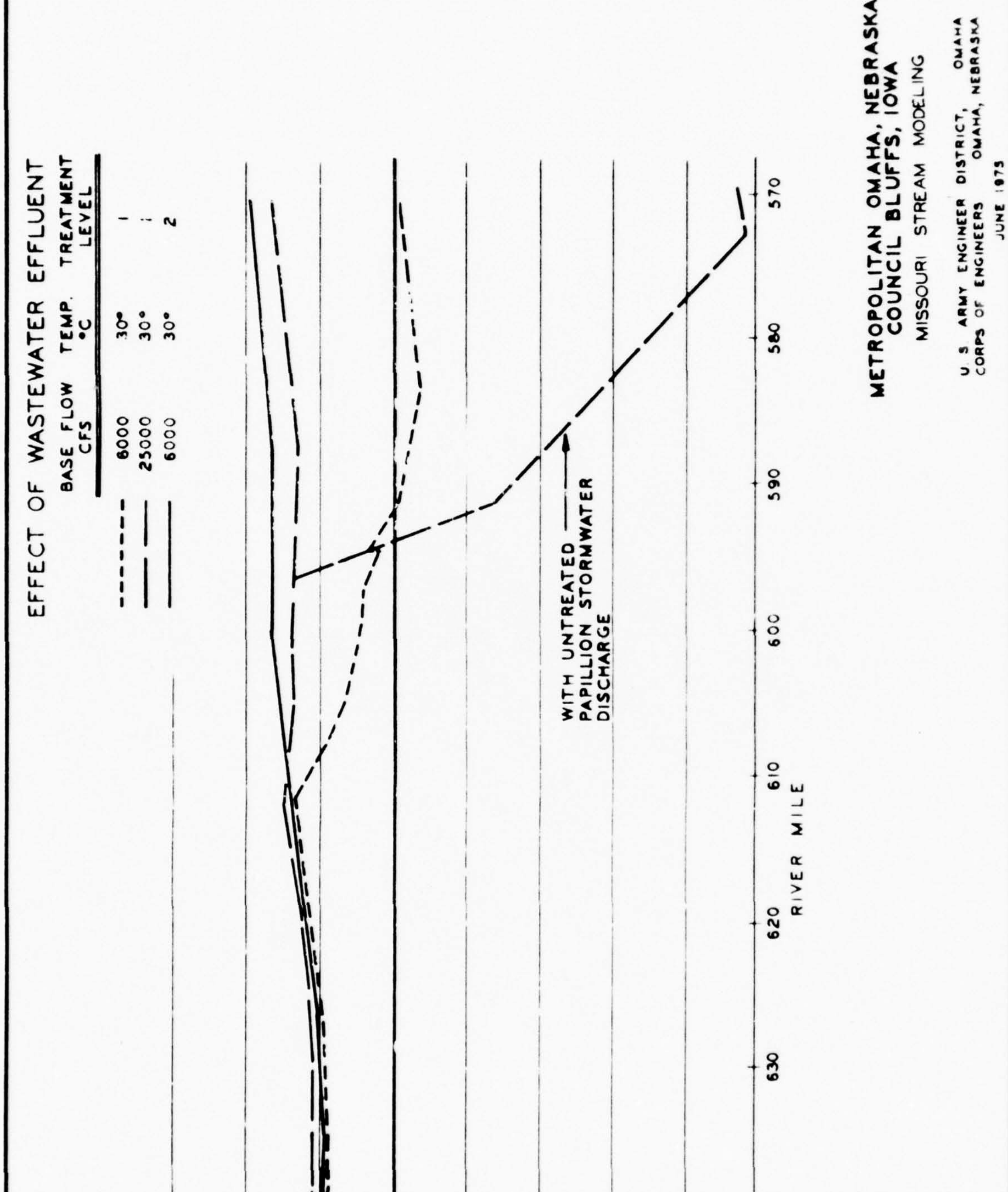


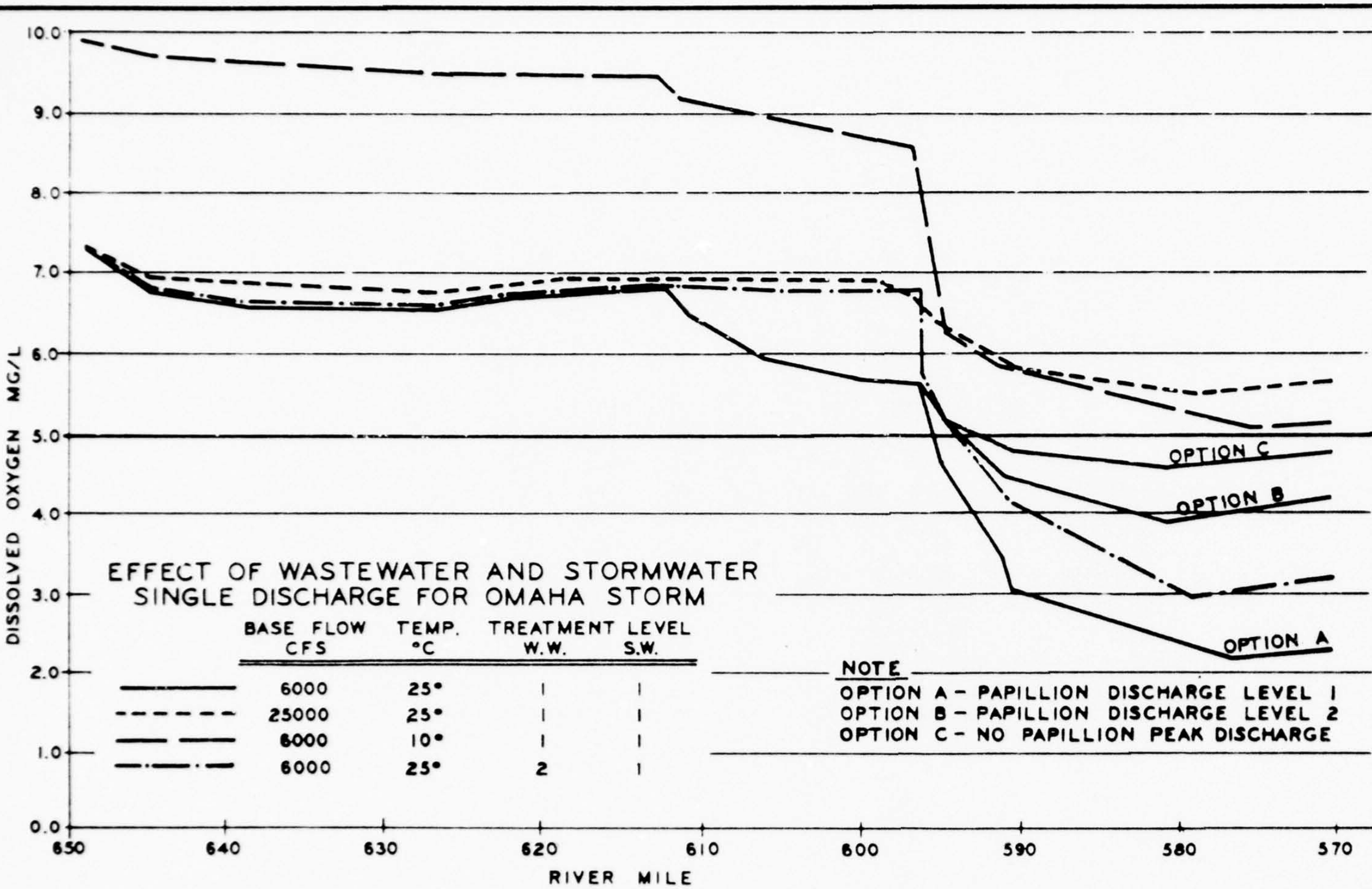
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

BIG PAPILLION CREEK
RIVER MILES VS
QUALITY AND FLOW
ONE YEAR STORM TREATMENT

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975


EFFECT OF WASTEWATER EFFLUENT
BASE FLOW CFS
TEMP. °C
TREATMENT LEVEL
6000 30° 1
25000 30° 1
6000 30° 2
WITH UNTREATED PAPILLION STORMWATER DISCHARGE
DISSOLVED OXYGEN MG/L
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
650
640
630
620
610
600
590
580
570
RIVER MILE
METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA
MISSOURI STREAM MODELING
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1973



METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

MISSOURI STREAM MODELING

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

JUNE 1975

VOLUME VII FIGURE C-12

does not support a fishery. Even after implementation of the alternative, the natural low flow, high temperature conditions of the stream would limit the fishery level. Improvement at the Missouri River ecosystem would result from removal of the urban runoff shock-load condition. The extent of improvement cannot be projected at this time.

225. Construction activities would have some disruptive effects although most construction would occur immediately adjacent to the streams. The storage basins could be landscaped and would blend well into open space areas.

226. The EQ plan is upstream storage and treatment employing Level 2 treatment. The residual pollutant loads indicated in table C-14 are for Level 1 treatment. Level 2 treatment would reduce these loads to about 1,000 and 2,500 tons of BOD and suspended solids annually.

227. Social Well-Being (SWB). The SWB impacts would be an improvement in recreation potential and the effects on income. Removal of the runoff pollutants could aid in reducing adverse esthetic conditions now found along the stream and would make recreational use of the flood plain lands more attractive.

228. The costs to remove the stormwater pollutants is estimated to be $0.73 per month per customer for Level 1 treatment of the 1-year storm.

229. Regional Development (RD). The costs to implement the urban stormwater treatment plan would be incurred by the local municipalities, the States of Iowa and Nebraska, and the Federal Government.

As with the other wastewater plans, in Nebraska the capital costs would be shared 12.5 percent by local, 12.5 percent by State, and 75 percent by Federal agencies. In Iowa, the costs are 20 percent local, 5 percent State, and 75 percent Federal. All O&M costs would be paid for by the local municipalities.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

230. The most important criterion is certainty. Many people feel that stormwater treatment is too costly to implement. Public Law 92-500 requires that stormwater treatment be accomplished to comply with 1983 requirements of the law. This requirement appears to be economically infeasible and changes in the requirements of Public Law 92-500 are being examined (See Federal Register, Vol. 40, No. 103, May 28, 1975).

THE EFFECTS OF NON-STRUCTURAL STORMWATER ALTERNATIVES

231. As pointed out in the Wastewater Plan Formulation Annex of this report, there are some non-structural alternatives that would reduce the amount of urban runoff pollution. The following paragraphs contain a brief comparison of the structural and non-structural solutions for reducing stormwater pollution.

232. More efficient street sweeping can lower the amount of stormwater pollutants that originate from streets (see Annex D of Volume V. The city of Omaha currently follows about a 45-day sweeping frequency. By increasing the frequency to 12 days, the city can reduce the street pollutant load an additional 30 percent. Because street pollutants comprise 20 percent of the overall urban stormwater pollution, a 12-day street-sweeping frequency could reduce this source of pollution by 6 percent.

233. By routing impervious area runoff over a pervious area equivalent in size to the impervious area, storm runoff pollution from the impervious area can be reduced by 73 percent for low-frequency storms (see Annex D, Supporting Technical Reports Appendix). Assuming that 80 percent of the pollutants comes from the impervious areas (other than streets) during the low-frequency storms, storm runoff pollution could be reduced by 58 percent. This reduction would decrease until it reached near zero for a major design storm event.

234. Based on the above analysis, stormwater pollution could be reduced by 64 percent (58 plus 6), by implementation of the non-structural alternatives. This compares to 40 percent BOD reduction and 70 percent suspended solids removal with Level 1 stormwater treatment.

235. The non-structural alternatives appear to be very effective for the low-frequency storm events. The comparison may not be very good for a 1-year storm event and most likely becomes even worse for the higher frequency storm events. This should not deter city officials and developers from implementing these non-structural alternatives since they can be effective in reducing the amount of urban stormwater pollutants. It is apparent that a combination of non-structural and structural measures should be used to control urban runoff.

EVALUATION OF WET-WEATHER FLOW TREATMENT

236. The control and abatement of pollution from combined sewer overflows and separate urban storm runoff are as yet only roughly defined. The Environmental Protection Agency discusses these

special cases in its "Water Strategy Paper", Second Edition, February 1974. The following points developed in that strategy paper are relevant to the Omaha-Council Bluffs area:

- Unlike secondary treatment for treatment plants, there is not a generally recognized acceptable level of treatment for overflows and stormwater discharges.

- Overflows and storm sewers will not be considered publicly-owned treatment works for the purpose of complying with the effluent standards of secondary treatment for 1977 nor will a separate uniform effluent standard be promulgated for them. Correction of overflow problems will be defined in terms of meeting the applicable water quality standards of 1977 and the fishable/swimmable standards of 1983. "Meeting water quality standards" is itself a concept which will be further defined in guidance by EPA.

- An additional consideration in examining the need for correction of wet-weather flows results from correlating the water use to be protected (as an example, swimming), with the season and frequency of rainfall. If swimming activities occur only during a season when there is little or no rainfall, correction of wet-weather flows may be unwarranted. For most streams in the study area, the actual use is probably not being affected by wet-weather pollutants.

237. In light of the above EPA strategies, the wastewater management study has considered a range of storm events and treatment levels for wet-weather flows. Storm events ranged from 1 to 10 years; treatment levels ranged from 40 percent BOD and 70 percent

suspended solids removals to near "zero discharge". The effects of do-nothing and the alternatives were modeled using dissolved oxygen as the modeled parameter. Based on the modeling, the 1-year design storm was selected for all urban wet-weather flows. Treatment levels were provided to maintain stream-dissolved oxygen according to existing State standards.

238. The limitations of the stormwater analysis must be stated. Limitations are apparent in three areas: pollutant load, modeling, and ecological effects.

239. The stormwater analysis used primarily simulated data from the studies applied to specific land uses. The pollutant load values used did not differentiate between old and new urban areas. Analysis of the street sweepings (see Volume V - Annex D) indicates a significant differential between old and new urban areas pollutant loads; the newer urban areas exhibited much lower pollutant loads than the older areas.

240. Modeling used in the study does not account for other types of organic and inorganic pollutants in the wet-weather flows. Modeling for most of these other pollutants is not possible.

241. The DOSAG model, which was used for the water quality impact modeling, is the static type which analyzes a slug of water as it passes through the stream. The dissolved oxygen at any particular time is based on a combination of oxygen-consuming materials, rate of deoxygenation of those materials, and natural reaeration of the stream. Under storm conditions and shock loads, none of the above may act in a static fashion.

242. It is not possible to define true ecological impacts for intermittent shock loads. Most small streams in the urban area are physically incapable of supporting diverse aquatic life. Urban pollutants entering the Missouri River are not readily dispersed but maintain a pollutant flume for several miles downstream. It is not possible to determine whether this lack of dispersion minimizes or maximizes overall ecological impacts, although the U. S. Fish and Wildlife Service has indicated that localized aquatic impacts would be much more severe.

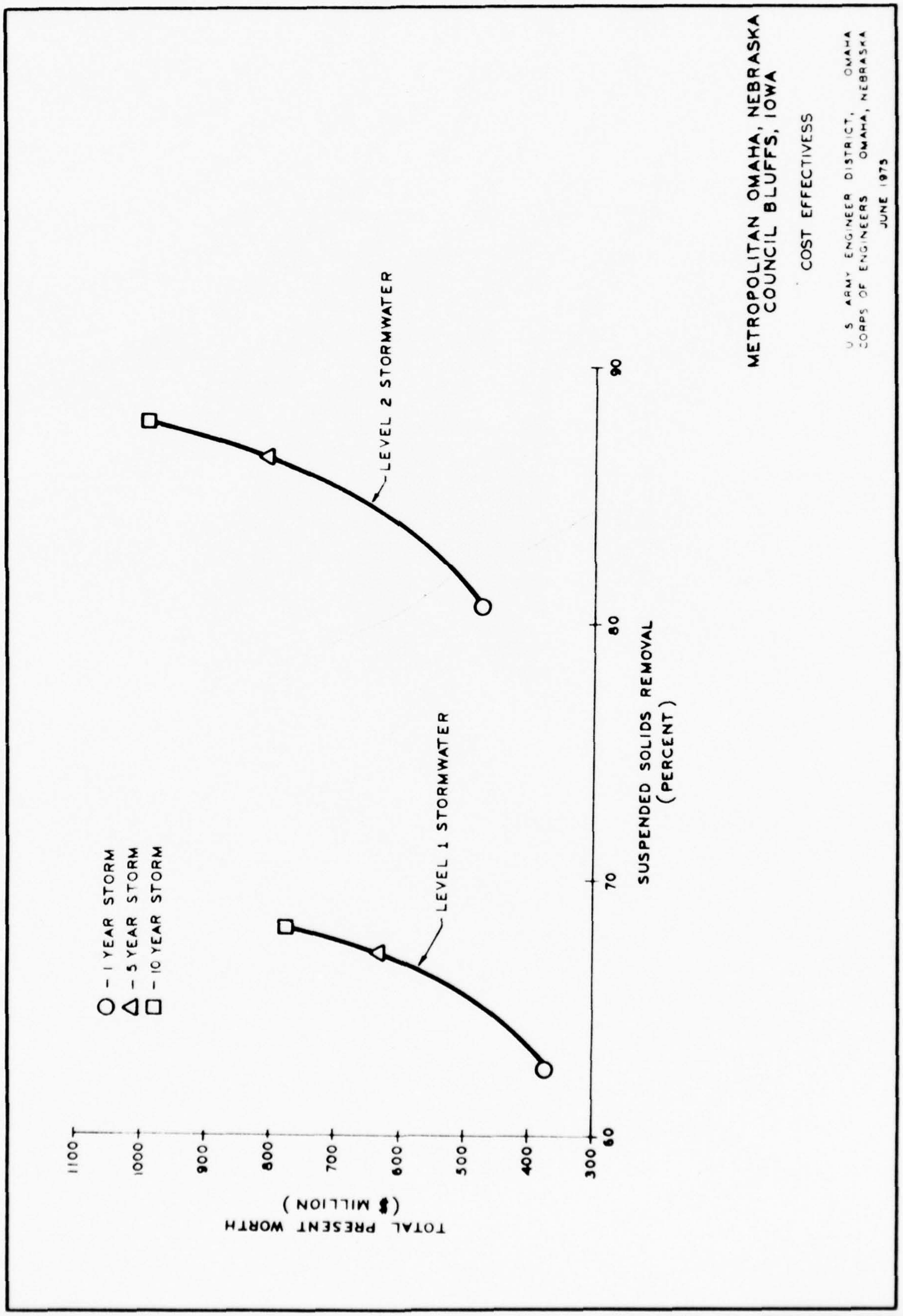
243. While the above limitations and uncertainties are evident, several valid conclusions can be made from the wet-weather flow analysis. These conclusions are discussed below.

- Treatment of combined sewer overflows and urban storm runoff is required to maintain State water quality standards.

- Retention of the 1-year storm coupled with treatment will maintain water quality standards for dissolved oxygen.

- It is more cost-effective to increase treatment levels rather than storage capacity. Relatively slight increases in pollutant removal results in considerable additional investment when the storage capacity is sized for larger than the 1-year storm event. Figure C-13 illustrates this conclusion.

- Retention of the 1-year storm will enable capture of the "first flush" of all storms and in excess of 94 percent of the total annual runoff.



VOLUME VII FIGURE C-13

Treatment of stormwater near the source provides flexibility for incorporating non-structural measures and results in more cost-effective solutions.

Water Supply

244. This section presents the impact assessment and evaluation of the water supply plans selected for further consideration. Three regional water supply plans, alternative supply sources, water use reduction concepts, and the effects of the alternative growth patterns on water supply will be evaluated here.

REGIONAL WATER SUPPLY PLANS

PLAN DESCRIPTION

245. Three regional water supply plans and a do-nothing alternative are described and their significant impacts are indicated in table C-15. The plans are subdivided between the non-metropolitan and metropolitan area. Plan II, as originally formulated, contained an additional Platte River well field near Valley, Nebraska. The economic advantage of this well field is large enough, however, to bias an equivalent evaluation of all three plans. Therefore, for evaluation purposes, all three plans use a new Missouri River supply source which is the alternative to a new Platte River well field. Either a new Platte River well field or an additional Missouri River supply source can be used with all three plans. A comparison of the Platte River versus Missouri River sources was evaluated separately and is discussed later.

Table C-15
Summary Comparison of Alternative Water Supply Plans

	Do-Nothing	Plan I	Plan II	Plan III
A. Plan Description				
1. Non-metro area	Fifty-three municipal systems; 13,188 individual well supplies.	Thirty-one rural water systems covering entire non-metro area; twenty-two treatment plants.	One treatment plant per county; distribution system county wide.	One plant serves Washington and Harrison Counties; Pottawattamie County served by Council Bluffs; Mills County served by MUD; two supply sources for Cass County.
2. Metro area	Implementation of Council Bluffs' and MUD's master plans.	Implementation of Council Bluffs' and MUD's master plans; 3 Missouri River plants and one Platte River plant serve metro-area.	Same as Plan I except MUD service extended to all of Douglas and Sarpy Counties; Council Bluffs extended to all of Pottawattamie County.	Same as Plan II except MUD service extended to Mills County.
B. Significant Impacts	Forty-Two communities with aesthetic water quality; four with health problems; water shortage possibly in twenty-six communities; rural population decline.	All residents receive reliable supply meeting USPHS standards; fire protection enhanced; rural population and economic activity stabilized or increased.	Same as Plan I with increased supply reliability and lower management costs.	Same as Plan II.

246. The do-nothing alternative represents the water system that will result in the study area in the absence of water supply plans. Under this alternative, the metropolitan systems would continue to expand, rural municipalities would upgrade and expand their own facilities, and rural residents would continue to supply themselves on an individual basis.

247. The other three plans mainly test supply and treatment regionalization concepts directed primarily at providing service to the non-metropolitan areas. Plan I features localized supply, treatment, and distribution systems. Plan II features one central supply source and treatment plant per non-metropolitan county with the urban plants serving some rural areas. Plan III features supply and treatment plants serving more than one county.

CONTRIBUTIONS TO PLANNING OBJECTIVES

248. The planning objectives for the water supply plans are: (1) to provide a reliable supply to all seven-county residents that meets the 1962 Public Health Service recommendations and the 1974 Safe Drinking Water Act Standards; and (2) to provide adequate storage to meet emergency situations.

249. The do-nothing alternative contains the current plans of the Omaha Metropolitan Utilities District (MUD) and of Council Bluffs. Implementation of these plans would provide satisfactory achievement of the planning objective for the urban residents.

250. For the non-metropolitan areas, very little accomplishment of the planning objectives would be achieved under the do-nothing alternative. There are only three water systems in the study area that currently meet all the planning objectives.

251. The three water supply plans provide comparable achievement of the planning objectives.

RELATIONSHIP TO THE FOUR ACCOUNTS

252. Each plan's contribution to the four accounts is displayed in table C-16.

253. National Economic Development (NED). Beneficial NED impacts include the value of increased output of goods and services, including water supply, fire insurance, and water softening, and the value of output from the use of unemployed labor resources in construction. Because the market value of municipal water supply does not reflect the user's valuation, the economic value of water must be imputed. In this study, the cost of the do-nothing alternative approximates the value of water. The present value of the do-nothing alternative is $396,400,000.

254. The costs for the do-nothing alternative were computed based on the following assumptions. The costs for the municipal water supplies were based on selected price data assuming that water is presently priced at the level to recover all costs, capital, and operation and maintenance. The average cost of a rural domestic well is $2,500 as estimated by a local well-drilling firm for a 180-foot well in eastern Pottawattamie County. The average cost of operating a well was estimated at $50 per year, an approximation of the cost of electricity to run the well. It was assumed that each existing well must be replaced one and one-half times before 2020, which is roughly equivalent to a useful life of 30 years. Actually, a domestic well would have a longer useful life - in the range of 40 to 50 years. The shorter useful life was used to calculate depreciation to make some allowance for

Table C-16
System of Accounts - Water Supply Plans

Accounts	Footnotes 1/	Do-Nothing	Plan I	Plan II	Plan III
1. National Economic Development					
(Present value in million $)					
A. Beneficial Impacts					
(1) Value of increased output of goods and services					
Water Supply	3, 5, 7, 9	396.4	396.4	396.4	396.4
Fire Insurance	3, 5, 7, 9		4.4	5.2	5.2
Water Softening	3, 5, 7, 9		19.8	24.0	24.0
(2) Value of output from use of unemployed labor resources					
Construction Labor	1, 4, 7, 9	27.3	30.2	29.6	29.6
(3) Total NED Benefits		423.7	450.8	455.2	455.2
B. Adverse Impacts					
(1) Value of resources required					
Metropolitan					
Capital	1, 5, 7, 9	225.2	220.2	218.9	218.9
O&M	3, 5, 7, 9	123.0	119.9	119.3	119.3
Total		348.2	340.1	338.2	338.2
Non-Metropolitan					
Capital	1, 5, 7, 9	36.2	82.0	76.9	76.6
O&M	3, 5, 7, 9	12.0	24.8	24.0	22.2
Total		48.2	106.8	100.9	98.8
Total Study Area					
Capital	1, 5, 7, 9	261.4	302.2	295.8	295.5
O&M	3, 5, 7, 9	135.0	144.7	143.3	141.5
Total		396.4	446.9	439.1	437.0
(2) Total NED costs		396.4	446.9	439.1	437.0
C. Net NED Benefits		27.3	3.9	16.1	18.2
D. Net NED Benefits/Costs		1.07	1.01	1.04	1.04

1/ Footnotes indexed at the end of table C-33.

Table C-16
(Cont'd)
System of Accounts - Water Supply Plans

Accounts	Footnotes 1/	Do-Nothing	Plan I	Plan II	Plan III
2. Environmental Quality					
A. Enhancement		none	none	none	none
B. Degraded					
(1) Treatment plants	1, 6, 8, 9	32	29	9	6
(2) Pumping stations	1, 6, 8, 9	12	50	51	53
(3) New pipelines, miles	1, 6, 8, 9	0	790	812	840
(4) New storage facilities	1, 6, 8, 9	0	136	137	136
3. Social Well-Being					
A. Beneficial Impacts					
(1) Enhancement of health, safety, and community well-being					
Meets standards	2, 6, 8, 9	No	Yes	Yes	Yes
Taste	2, 6, 8, 9	--	Improved	Improved	Improved
Appearance	2, 6, 8, 9	--	Improved	Improved	Improved
Staining	2, 6, 8, 9	--	Reduced	Reduced	Reduced
(2) Real income					
Soap costs	2, 5, 7, 9	--	Reduced	Reduced	Reduced
Corrosiveness	2, 6, 7, 9	--	Reduced	Reduced	Reduced
Staining	2, 6, 7, 9	--	Reduced	Reduced	Reduced
(3) Emergency preparedness					
Fire protection	2, 5, 7, 9	--	Improved	Improved	Improved
B. Adverse Impacts					
(1) Deterioration of quality of life, health, and safety. Number of targets required to disable the region's water supply.	2, 6, 8, 9	32	29	9	6

1/ Footnotes indexed at the end of table C-33.

Table C-16
(Cont'd)
System of Accounts - Water Supply Plans

Accounts	Footnotes 1/	Do-Nothing	Plan I	Plan II	Plan III
(2) Real income					
Average monthly cost per family in dollars.	3, 5, 7, 9				
Urban area		5.30	5.49	5.27	5.47
Washington County		6.70	22.95	20.00	21.00
Cass County		7.28	22.30	22.30	22.30
Harrison County		10.30	22.85	24.75	24.75
Pottawattamie County		10.90	26.60	25.25	25.25
Mills County		9.37	28.55	26.10	27.30
Percent of family income.	5, 8, 9				
Urban area		0.5	0.6	0.5	0.6
Washington County		0.9	3.0	2.6	2.7
Cass County		1.0	3.1	3.1	3.1
Harrison County		1.4	3.2	3.4	3.4
Pottawattamie County		1.3	3.1	3.0	3.0
Mills County		1.0	3.1	2.9	3.0
Percent of family income, poverty families.	5, 8, 9				
Urban area		3.3	3.4	3.3	3.3
Washington County		4.7	15.9	13.9	14.6
Cass County		4.4	13.5	13.5	13.5
Harrison County		6.0	13.3	14.4	14.4
Pottawattamie County		6.5	15.7	14.9	14.9
Mills County		6.4	19.6	17.9	18.7
(3) Emergency preparedness	2, 5, 7, 9				
Chemical requirements ($1,000/year)		1,937	2,057	1,899	1,963
Annual energy requirements (1,000 megawatts)		164	166	171	166

1/ Footnotes indexed at the end of table C-33.

Table C-16
(Cont'd)
System of Accounts - Water Supply Plans

Accounts	Footnotes 1/	Do-Nothing	Plan I	Plan II	Plan III
C. Population Distribution					
(1) Effect on alternative growth patterns	2, 5, 8, 10				
D. Economic Base and Stability					
(1) Crop acreage	2, 5, 8, 10				
(2) Livestock production	2, 5, 8, 10				
(3) Agribusiness as proportion of total industry	2, 5, 8, 10				

1/ Footnotes indexed at the end of table C-33.

Table C-16
(Cont'd)
System of Accounts - Water Supply Plans

	SMSA-NE	Pottawattamie Co. Council Bluffs	Pottawattamie Co. Remainder	Washington Co.	Harrison Co.	Mills Co.	Cass Co.	Total
4. Regional Development								
A. Income (million $, present value)								
Plan I								
(1) Beneficial impacts -								
Water supply	322.6	25.6	16.7	5.8	9.9	7.3	8.5	396.4
Unemployment	25.1	5.1					.	30.2
Fire insurance	0.5		1.4	0.5	0.8	0.6	0.6	4.4
Water softening	2.9		5.4	1.7	4.2	3.3	2.3	19.8
(2) Adverse Impacts -								
Value of resources required	314.5	25.6	28.5	17.7	18.7	25.8	16.1	446.9
(3) Net regional income effects	36.6	5.1	-5.0	-9.7	-3.8	-14.6	-4.7	3.9
Plan II								
(1) Beneficial impacts -								
Water supply	322.6	25.6	16.7	5.8	9.9	7.3	8.5	396.4
Unemployment	24.6	5.0						29.6
Fire insurance	1.3		1.4	0.5	0.8	0.6	0.6	5.2
Water softening	7.1		5.4	1.7	4.2	3.3	2.3	24.0
(2) Adverse impacts -								
Value of resources required	312.6	25.6	23.3	16.8	19.0	23.1	18.7	439.1
(3) Net regional income effects	43.0	5.0	0.2	-8.8	-4.1	-11.9	-7.3	16.1
Plan III								
(1) Beneficial impacts -								
Water supply	322.6	25.6	16.7	5.8	9.9	7.3	8.5	396.4
Unemployment	24.6	5.0						29.6
Fire insurance	1.3		1.4	0.5	0.8	0.6	0.6	5.2
Water softening	7.1		5.4	1.7	4.2	3.3	2.3	24.0
(2) Adverse impacts -								
Value of resources required	312.6	25.6	22.7	15.9	18.3	21.9	20.0	437.0
(3) Net regional income impacts	43.0	5.0	0.8	-7.9	-3.4	-10.7	-8.6	18.2

the cost of major repairs. These costs were distributed evenly over the next 45 years. The costs used in the metropolitan area are the same as those used in Plan 1 of the alternative plans, assuming that the Metropolitan Utilities District and Council Bluffs implement their existing master distribution plans.

255. The value displayed for fire insurance is based on the concept that persons living outside the Omaha-Council Bluffs metropolitan area will pay less for fire insurance if a regional water supply plan providing a pressurized water source at each residence is implemented. Currently, 34 communities have either inadequate storage or supply capabilities for emergency situations. Rural residents rely primarily on low-yield wells. Data were collected concerning the cost of fire insurance in different localities. It was assumed that one-half of the rate differential between the Omaha-Council Bluffs metropolitan area and the outlying areas was due to a lack of a readily available pressurized water supply. The rate differential (adjusted) was multiplied by the number of residences in the outlying areas. The result was considered the estimated annual benefit for lower fire insurance premiums.

256. Water-softening benefits were included because of the significant lowering of hardness that would result in the non-metropolitan areas if a regional water supply plan is implemented. Using the consultant's report as a data source, an inventory was taken of all towns using untreated hard water. Water that exceeded 180 mg/l was considered hard.

257. Based on discussions with local water-softening companies, it was estimated that there is a $4.47 per month per family

difference between softening the very hard water in the rural and non-metropolitan areas and softening water in the Omaha-Council Bluffs metropolitan area. Since all of the water supply plans feature a hardness equivalent to that currently supplied by the two major utilities, total water-softening benefits were derived by multiplying the number of non-metropolitan families served by a regional system by $4.47 per month. The present values of these benefits are included in the NED account.

258. Use of unemployed labor resources is considered as an addition to the benefits resulting from a plan. Only direct labor during construction is included. One-half of the construction cost was assumed to be direct labor costs. A certain portion of this direct labor was assumed to consist of people that would otherwise be unemployed. Local construction firms indicated that up to 70 percent of the work force on such jobs would come from the unemployed sector. Because the sporadic nature of construction, employment is likely to cause this percentage to be inflated, and because the National unemployment rate in the construction industry is approximately 13.7 percent, the estimated portion of construction workers that otherwise would be unemployed was reduced to 20 percent. The value of output from use of unemployed labor resources was calculated by multiplying the construction cost by one-half and then by 20 percent.

259. Total NED benefits shown in table C-16 are the sums of the cost of the do-nothing alternative and 10 percent (1/2 x 20%) of the construction cost.

260. Adverse NED impacts include the present values of the capital, operation, maintenance, and replacement costs. Volume V - Annex K

should be consulted for the cost breakdown and phasing of the expenditures.

261. Net NED benefits are the difference between the total NED benefits and total NED costs. Benefit-cost ratios for the four alternatives are:

Do-Nothing	1.07
Plan 1	1.01
Plan II	1.04
Plan III	1.04

262. Plan II and Plan III have comparable benefit-cost ratios. Plan III actually had a slightly lower present worth value. The institutional analysis determined that Plan III would probably be infeasible compared to Plans I and II. Therefore, Plan II is selected as the NED plan.

263. Environmental Quality (EQ). There are no known characteristics of any of the alternatives that are likely to enhance environmental quality. It is assumed that each alternative would be implemented in a manner that would minimize degradation of environmental quality. Potential plan features that tend to degrade environmental quality include treatment plants, pumping stations, pipeline construction, storage facilities, and sludge handling facilities.

264. All of the treatment facilities in Plans I, II, and III are equipped with adequate water treatment, sludge handling, and treatment facilities to avoid adverse water quality effects.

265. Use of a new Platte River supply source could have some environmental effects which will be discussed later.

266. Either Plan I or II constitutes the EQ plan primarily because the environmental effects are similar and because Plan III has less of a chance for implementation as discussed under the NED account.

267. Social Well-Being (SWB). Impacts on social well-being include those associated with health, safety, and community well-being, changes in real income, and emergency preparedness.

268. Beneficial SWB impacts include a measure of each plan's health enhancement potential, such as the ability to meet the Interim Primary Drinking Water Standards promulgated by the Environmental Protection Agency; adequacy of supply, taste, and appearance, increase in real income as a result of reduction in soap use, and reduced corrosiveness and staining; and improvement of emergency preparedness for fire protection. The SWB benefits are displayed in table C-16.

269. Plans I, II, and III are designed to meet the Interim Primary Drinking Water Standards. The Omaha and Council Bluffs water systems also meet the standards in the do-nothing alternative. These standards, however, are not met by 42 of the 53 communities in the area with the do-nothing alternative.

270. Twenty-six water systems under the do-nothing alternative do not have disinfection capabilities, thereby allowing risk of contamination either of the supply source or within the distribution systems. In addition, all individual water wells supplying rural residents do not have disinfection capability. Plans I, II, and III feature adequate disinfection capability to avert health hazards.

271. The available supply of water for the study period for both Omaha and Council Bluffs water systems is adequate in the do-nothing alternative; however, 15 of the 53 communities in the area were judged to have inadequate supplies with the do-nothing alternative. Supply is adequate through year 2020 with Plans I, II, and III.

272. A slight increase in real income would result from Plans I, II, and III in the rural areas because of a decrease in use of soap, reduction in corrosiveness, and reduction in staining of water fixtures, utensils, and clothing.

273. An increase in emergency preparedness attributable to increased water storage capacities would result in improved fire protection in Plans I, II, and III. Thirty-four communities under the do-nothing alternative lack either the supply capability or storage capability or both, for emergency situations.

274. Adverse SWB impacts include deterioration of safety against sabotage by centralization of facilities, reduction in real income of individuals caused by the cost of the plan, and reduction of the ability to respond to emergency situations because of the increased use of energy and chemical resources.

275. Although table C-16 indicates a significant difference in the number of treatment plants associated with each concept, over 85 percent of the population would be served by the four major metropolitan plants in all plans. Therefore, the number of citizens that would be affected by sabotage of the facilities is relatively equal under all plans.

276. Average monthly cost per family was obtained by dividing the estimated amortized capital cost, and operation and maintenance cost for the year 2020 by the number of families projected for the year 1995 in Growth Concept A. Since the costs are average annual equivalent, the use of 1995 customers represents a near average cost over the planning period. The amortized capital costs used in this analysis were reduced from the total capital costs by a figure representing a $1,000 initial hookup fee for rural residents in Plans I, II, and III.

277. The monthly costs shown in table C-16 are indicative of the magnitude of actual billings that would occur under each plan. They do not, howevever, represent a rate schedule, the design of which is beyond the scope of this study.

278. While the average monthly cost per family in the urban area only varies from $5.30 to $5.49 for the alternatives, costs per family in the non-SMSA counties of the region vary from $6.70 to $10.90 per month for the do-nothing alternative and from $20.00 to $28.55 per month for the other alternatives. The average monthly cost per family is also shown in table C-16 as a percentage of the mean 1970 family income. Approximately 0.5 to 0.6 percent of the mean family income is required to finance all alternatives for the urban areas. In the nonurban counties, this value is higher and varies from 0.9 percent for Washington County to 1.4 percent for Harrison County for the do-nothing alternative and is much higher in the rural counties, varying from 2.6 percent for Plan II in Washington to 3.1 percent for Plan I in Mills County.

279. Approximately 6.8 percent of the families in the SMSA had incomes below the poverty level in 1970. Families with incomes

below the poverty level in the rest of the region varied from 8.4 percent in Washington County to 11.7 percent in Harrison County. The average monthly cost per family is shown in table C-16 as a percent of the mean family poverty income. Approximately 3.3 percent of the mean income of poverty families is required to finance all alternatives in the urban area. In the nonurban area, 4.7 to 6.0 percent of the income of the poverty families would be required to finance the do-nothing alternative and from 13.3 to 19.6 percent would be required to finance the other alternative plans. Actual costs to poverty families are likely to be less because water supply billings are generally based on use, and water use varies directly with income. It should be emphasized that the discussion above is based on an estimated cost per family, not on an average monthly billing per family. An average monthly billing per family would depend on water pricing policies. Such a policy could be designed to alleviate economic hardship on low-income groups.

280. Adverse effects on emergency preparedness include the increased usage of chemicals and energy requirements. Chemical requirements are displayed in table C-16 in increments of $1,000 per year. Plan II is least chemical-consumptive and Plan I is most chemical-consumptive. There is, however, not a significant difference in the amount of chemicals consumed in any of the alternatives, including the do-nothing alternative. Energy requirements vary from 164,000 megawatts annually for the do-nothing alternative to 171,000 megawatts annually for Plan II. Based on the above, chemical and energy usages are not significant plan decision variables.

281. Regional Development (RD). Impacts on regional development are associated with regional income, population distribution, and economic base and stability.

282. Income impacts are represented by the incidence of the NED benefits and costs among entities within the region. Total benefits and costs for each alternative were allocated among entities by adding the separable costs and a share of the joint costs for shared systems. Joint costs include both capital and O&M costs. Each entity's share of the joint capital cost was allocated on the basis of maximum daily demand. Operation and maintenance costs were allocated on the basis of average daily demand. Water supply beneficial impacts for each alternative shown in table C-16 are the costs of the do-nothing alternative. Unemployment benefits are the difference between the unemployment benefits for the do-nothing alternative and each alternative plan. Unemployment benefits were assumed to accrue to the SMSA. Therefore, net regional income effects shown in table C-16 represent the difference between each alternative plan and the do-nothing alternative.

283. Implementation of any one of the three alternative plans would result in positive income effects for the urban portions of the study region and negative income effects in the small communities and rural areas. Thus the cost of the alternative plans bear heavily on the lower-income areas of the region. This effect is due primarily to the prevailing lower incomes in the non-metropolitan areas which are also the areas requiring the largest water supply investment. This represents an undesirable redistribution of income which could be offset by basing the allocation procedure on something other than use which, in effect, would be a subsidy from the urban to the rural areas and small communities. The

undesirable redistribution of income could also be offset by direct Federal assistance in developing the rural water systems possible under grants or low-interest loans from the Farmers Home Administration.

284. Population distribution may be affected by implementation of particular water supply alternatives. The do-nothing alternative would limit the quantity and quality of water supplies outside the existing metropolitan water service area. This, in turn, would tend to promote redevelopment of older areas and higher-density growth on the urban fringes. This type of growth characterizes Alternative Growth Concept C.

285. Alternative Water Supply Plans I, II, and III would provide adequate quantities of high quality water to the entire region. This would tend to promote continued low-density urban sprawl, and the possibility of the development of satellite cities. These growth characteristics are consistent with Alternative Growth Concepts A, B, and D, depending on the controls exerted on growth. Lack of control on growth would result in Growth Concepts A and D while controlled growth could lead to Growth Concept B. Impacts would occur on the regional economic base and stability. Slight decreases in cropland may result from Water Supply Plans I, II, and III because of influences on the land-consuming growth alternatives. Livestock production may increase if Plan I, II, or III is implemented because of improved water quality and quantity dependability. Agribusiness, as a proportion of the total economic base of the region, may increase with Plans I, II, and III because the regional supply plans would promote business in the rural communities and these communities tend to attract agribusiness.

286. From 1960 to 1970 the rural areas exhibited a population shift to urban areas. It is not known whether this shift will continue through the 1970's. At any rate, a high quality, dependable water supply would aid in stabilizing population and economic activity in the rural areas.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

287. The two most important associated criteria are the plan's acceptability and certainty. Portions of Cass County and Washington County have found the do-nothing alternative unacceptable and are taking measures to implement localized rural water systems. Other areas appear to accept the do-nothing alternative until a crisis situation develops.

288. Each county, with the exception of Douglas and Sarpy Counties, has a county water plan to avert such crisis situations. Plan I is based on the existing county plans. The main attribute of Plan I is that it is composed of multiple rural water systems. This attribute, while expensive, allows relatively localized areas to act independently on their water supply needs rather than requiring an entire county to act simultaneously. Areas without a water supply crisis see little benefit in joining a system that will reduce their real income, therefore, presenting an obstacle to countywide action.

289. For the above reasons, Plan I is probably the most acceptable and implementable plan.

290. The second criterion is certainty. While Plan I is more acceptable, there exists uncertainty regarding the ability of some

of the local aquifers to consistently produce the desired water quantity. Exploratory well drilling would be required before this uncertainty could be removed.

291. Plan II and Plan III, on the other hand, feature supply centralization to the most reliable source which in most instances is the Missouri River. Even with projected surface flow depletions, either the Missouri River surface flow or ground waters have more than adequate capability to meet water supply demands beyond the planning horizon. Plan II or Plan III must be considered the more certain plans at least where supply adequacy is concerned.

ALTERNATIVE METROPOLITAN SUPPLY SOURCES

292. A major economic consideration in metropolitan Omaha water supply plans is the location of a third major source to supplement the existing two major supply and treatment facilities. The third source must be developed in the early 1990's.

293. Alternative locations of the new source are on the Missouri River south of Omaha and on the Platte River west of Omaha. These locations were evaluated in detail in the MUD Master Plan and the Platte River west site was recommended. Increased supply and treatment capacity in the area of MUD's Florence treatment plant to meet water needs to 2020 was a third alternative. This third alternative was found not to be cost-effective when compared to the Missouri River south site. This was due primarily to the increase in transmission facility costs which would range from $8,750,000 to $13,660,000.

294. Cost differentials between Missouri River south and Platte River west source locations are summarized on an annual basis in table C-17.

295. Of major economic concern are increased chemical, primary pumping, and secondary pumping costs associated with the Missouri River south site versus the Platte River west site. Chemical costs savings reflect the generally more desirable quality of Platte River valley ground water versus either Missouri River surface water or Missouri River valley ground water. A higher treatment plant ground elevation and more direct route to developing usage centers are responsible for the pumping cost savings. Power and fuel costs for pumping are reduced and less booster station capacity is required.

296. The present value of water supply savings if the Platte River west site is developed amounts to $4,600,000.

297. Four additional factors are important in evaluating the Platte River west site. These are source availability and reliability, highest and best use of the water, the impacts of the well field on surface flows, and urban growth implications.

298. Surface flows provide direct recharge of ground waters along the Platte River. The Platte River west well field would tap an aquifer estimated to be able to produce 135 mgd for 61 days at zero flow conditions in the Platte River. Current plans call for an initial 50 mgd Platte River west facility by 1993 with a 50 mgd increase by 2004. Average daily treatment by 2020 is projected at 74 mgd under Growth Concept A.

Table C-17

ANNUAL COST COMPARISON - MISSOURI SOUTH VS. PLATTE WEST SOURCE

($1,000/YEAR)

Con-cept	YEAR	AVERAGE TREATMENT (mgd)	ANNUAL OPERATION AND MAINTENANCE TREATMENT AND PUMPING				AMORTIZED CAPITAL		TOTAL ANNUAL SAVINGS	SAVINGS
			CHEMICAL	POWER & FUEL	SLUDGE HANDLING	OTHER	SLUDGE HANDLING	PUMPING		(¢/1000 gal)
Missouri River Valley Ground Water										
A	1995	41.35	173.3	168.4		10.1		271.4	623.2	4.1
	2020	73.73	308.9	326.4		20.7		271.4	927.4	3.4
B	1995	37.42	156.8	124.9		6.4		61.7	349.8	2.6
	2020	55.74	232.1	144.4		5.4		61.7	443.6	2.2
C	1995	35.61	149.2	107.5		5.0		111.0	372.7	2.9
	2020	60.17	252.1	174.8		7.7		111.0	545.6	2.5
D	1995	43.17	180.9	170.9		10.1		264.0	625.9	4.0
	2020	72.64	304.4	322.3		20.4		264.0	911.1	3.4
Missouri River Water										
A	1995	41.35	80.4	168.4	50.9	10.1	168.9	271.4	750.1	5.0
	2020	73.73	143.4	326.4	84.0	20.7	166.9	271.4	1014.8	3.8
B	1995	37.42	72.8	124.9	47.0	6.4	115.8	61.7	428.6	3.1
	2020	55.74	108.4	144.4	65.5	5.4	115.8	61.7	501.2	2.5
C	1995	35.61	69.3	107.5	45.1	5.0	130.3	111.0	468.2	3.6
	2020	60.17	117.1	174.8	70.1	7.7	130.3	111.0	611.0	2.8
D	1995	43.17	84.0	170.9	52.8	10.1	154.5	264.0	736.3	4.7
	2020	72.64	141.3	322.3	82.7	20.4	154.5	264.0	985.2	3.7

299. Two existing major well fields are located downstream of the proposed site. These are the city of Lincoln's well field and the existing Omaha-MUD well field. Lincoln's well field is capable of producing 130 mgd (year 2000 demand) for 19 days without surface recharge. MUD's current well field requires continual surface recharge to produce its projected capacity of 80 mgd. During the 1974 drought year, this well field had difficulty producing 60 mgd. Thus both existing downstream well fields are critically dependent on surface flows.

300. The Platte River Basin Level "B" Study has projected low flows for the river and discusses two alternative levels of irrigation development in the basin. The Beta Plan represents a maximum irrigation development while the Alpha Plan represents a minimum irrigation development. Under the Beta Plan, there is a high probability that extremely low flows (less than 100 c.f.s.) would occur near the Platte River west well field in 18 months out of 18 years.

301. The Platte Level "B" Study shows that the river near the proposed well field could be dry about 1.5 percent of the time under the Alpha Plan and 4 percent of the time under the Beta Plan. Under the Beta Plan, the river could be dry up to 5 consecutive months in extremely dry years. This most severe case would not be in full effect until 2020.

302. The effect of well field pumping on the Platte River flow was also investigated as part of the Platte Level "B" Study. In the case of the proposed Platte River west site, 98 percent of the withdrawal will come directly from the Platte River after an initial pumping period of 1.69 years. This means that for each

100 mgd of well field withdrawal, 63 c.f.s. will be removed from the Platte River surface flow. This effect could seriously diminish the already projected low flows, greatly affect the Platte River ecosystem, and adversely affect the downstream well fields.

303. Both the Fish and Wildlife Task Force for the Platte Level "B" Study and the U. S. Fish and Wildlife Service have recommended maintenance of at least the average monthly flow that is exceeded 60 percent of the time over a period of years. The flows established are listed in table C-18.

304. When flows are higher than the minimum flows listed, water could be extracted from the Platte. If the flows are naturally less than the above amounts, then the natural flow is recommended. Currently, the surface flows past the well field are more than 560 c.f.s. 99 percent of the time. If the minimum flows indicated in table C-18 are established and enforced, the Platte well field will have minimum effect on the surface flows of the river and hence also on the two existing downstream well fields. If the minimum flows are not adhered to, a new Platte well field for Omaha will further compound a possible problem.

305. The U. S. Fish and Wildlife Service has recommended that the Missouri River south site be selected over the Platte River west site. That agency, in addition to noting pronounced ecological effects, states that reduced flows would enhance the invasion of trees and other woody vegetation in the streambed. This would have the effect of reducing the stream channel capacity, thereby conveying high flows and increasing flooding.

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WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY. VOLUME VII. --ETC(U)

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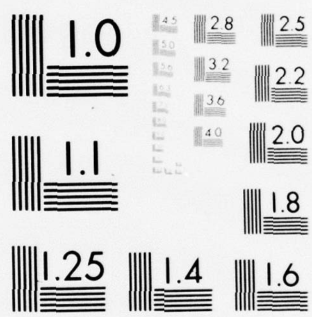


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table C-18
Recommended Minimum Platte River Flows
(c.f.s.)

Stream Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Lower Platte-N. Bend	2,560	3,250	2,690	2,680	3,920	5,150	4,180	3,960	3,680	1,860	1,330	1,670
Lower Platte-Ashland	2,710	3,520	3,200	2,670	4,920	7,120	5,390	6,390	6,490	4,060	2,020	2,220

306. Based on the above discussion, controls on Platte River water development are necessary to prevent adverse environmental conditions. Priorities on use of Platte River water must be set.

307. To determine the value of Platte River water for municipal and industrial use versus agricultural use, an economic analysis was performed to determine the present worth of each use.

308. The 1975 present value of savings to MUD customers if the Platte River west site is developed rather than the Missouri River south site (ground water), is $400,600,000. After making certain assumptions, it was estimated that the present value of profits foregone by irrigators if they are denied the use of irrigation water from Platte River sources is $400,000. The following assumptions were made in arriving at the figure of $400,000:

A 70-day irrigation season. With the Platte River west average daily treatment of 50 mgd, this results in 3,500 million gallons of water not available for irrigation.

- Corn was the irrigated crop.
- Dryland corn yields 64.5 bushels per acre.
- Irrigated corn yields 125 bushels per acre.
- The cost per acre for center pivot irrigation would be $71.46 (made up of both fixed and variable costs).
- A 12-inch application rate was assumed.
- The price of corn would be $1.64 per bushel.

309. In order for the value of the lost irrigation opportunity to equal the cost savings to MUD customers in developing the Platte River west site rather than the Missouri River south (ground) site, the value of corn must be $4.84 per bushel. The present value of corn is $2.75 per bushel.

310. There is concern among the public that the Platte River west supply source and transmission main would be an inducement to further westward urban sprawl of Omaha. This problem could be remedied by restricting connections to the transmission line.

311. In summary, the Platte River west supply source would be:

- Economically advantageous to development.

- Reliable if surface flows recommended by the Fish and Wildlife Task Force for the Platte Level "B" Study and the U. S. Fish and Wildlife Service are maintained; questionable reliability if they are not.

- Not a cause of adverse environmental problem by itself unless flows reach critical low levels.

- Not a cause of urban sprawl if restrictions are provided in transmission line connections.

312. Based on the above, development of the Platte River well field was labeled the NED plan and development of the Missouri River alternative was labeled the EQ plan.

WATER USE REDUCTION CONCEPTS

313. Water use reduction was not integrated into the design of the plans but was included as an option for local decision makers because of significant cost savings. The main reduction concepts evaluated are the use of water-conserving fixtures and appliances in all new housing units.

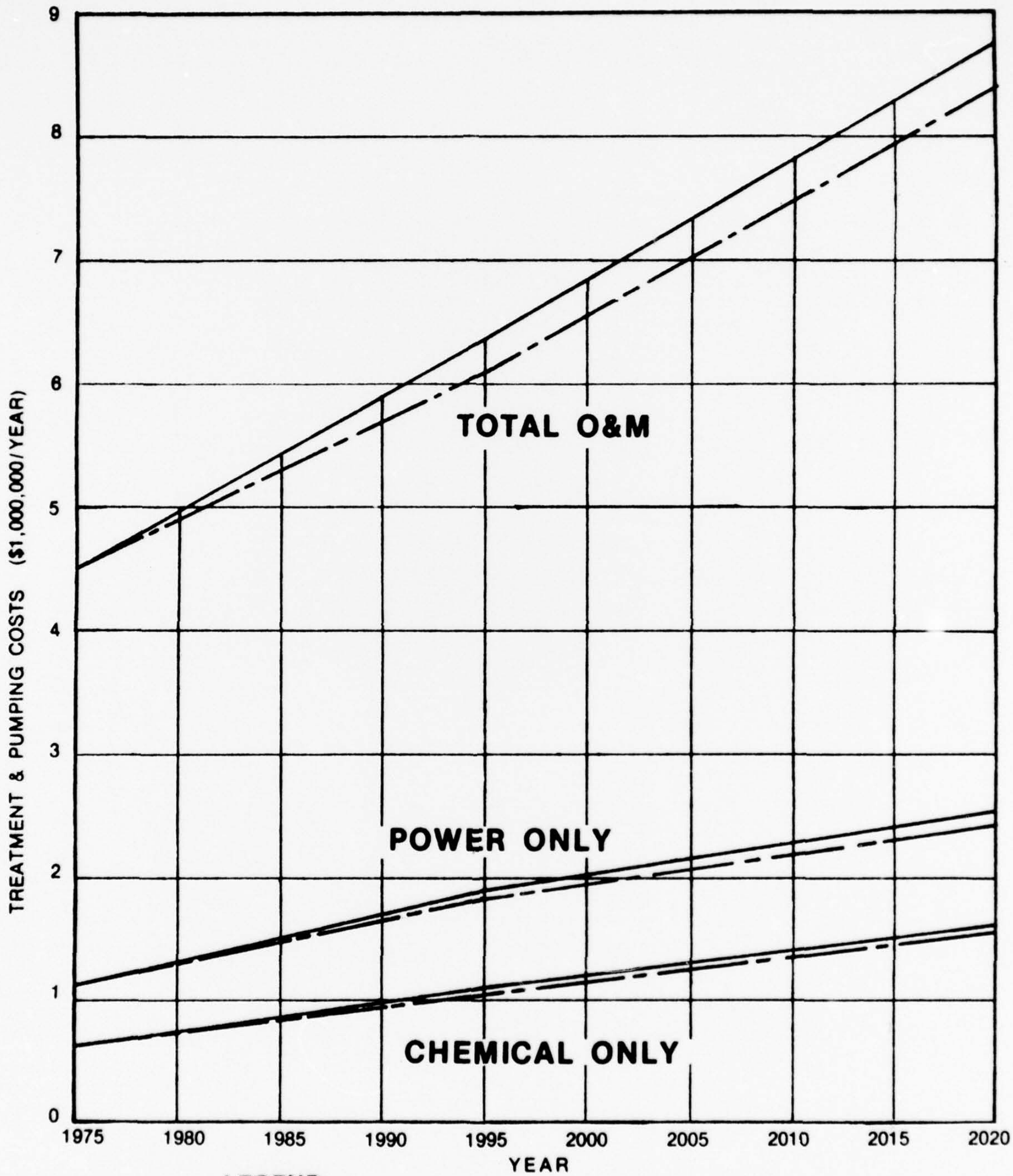
WATER SUPPLY SAVINGS

314. Annual operation and maintenance cost savings for water supply due to water use reduction are proportional to the reduction in average daily usage. Annual savings in total O&M, power, and chemicals for Omaha and Council Bluffs are depicted in figure C-14. The use of three major water-conserving fixtures results in a 31 percent reduction of in-house use. The three water-saving fixtures are water-saving toilets, flow-reduction shower heads, and water-saving washing machines. This reduction in use results in a 4-percent savings in O&M costs or approximately $300,000 per year by 2020.

315. Capital costs are proportional to peak-day and peak-hour demands. Present worth capital savings, resulting from 100-percent use of water-conserving fixtures, would be $2,900,000. Similar percent reductions are realized with the other growth concepts.

WASTEWATER TREATMENT SAVINGS

316. Assuming an 80 percent residential in-house water usage, the 31-percent water supply decrease would become a 39-percent wastewater flow reduction for in-house usage. The effects of this reduction are an estimated 16-percent flow decrease at the Missouri River plant, a 19-percent decrease at the Mosquito Creek plant, and a



LEGEND

PRESENT TREND CONSUMPTION

REDUCED CONSUMPTION LEVELS DUE TO FLOW REDUCTION APPLIANCES & DEVICES

METROPOLITAN OMAHA, NEBRASKA
COUNCIL BLUFFS, IOWA

EFFECT OF REDUCED WATER CONSUMPTION

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JUNE 1975

VOLUME VII FIGURE C-14

36-percent decrease in flow at the Papillion Creek plant. The net decrease at each plant is dependent upon the percentage of residential flow to that plant.

317. If all the residents of the Papillion Creek service area were to use the water-conserving fixtures, a capital cost reduction of 9 percent and an operation and maintenance cost reduction of 13 percent would be realized. An analysis of the minor urban facilities indicated savings of 13 percent and 14 percent for capital and operation and maintenance, respectively. Treatment plant components that are sized on organic loadings are affected very little by wastewater flow reduction.

318. For the Papillion Creek plant, the flow reduction would amount to a present worth cost reduction of about $7,000,000.

ALTERNATIVE GROWTH CONCEPTS

319. The alternative growth concepts affect future water supply requirements in two ways. First, areas of residential, industrial, and commercial development differ among the four concepts, thus altering water demand centers. Second, density of development varies, thereby changing the quantity of water required by water users.

320. Constrained growth futures could result in lower water supply costs. Lesser sprawl in Growth Concepts B and C generally would lower all system component costs. If Platte River water availability dictates that a second Missouri River source is required, the constrained growth concepts would be less affected than would westward sprawl concepts as indicated in table C-19.

Table C-19
Alternative Growth Concept Cost Difference
Platte West vs. Missouri River South (1995)
($1,000)

	Growth Concept A	B	C	D
Annual Savings	750	400	420	675

321. Constrained growth would also reduce water consumption and enhance costs. The use reduction would result principally from reduced lawn irrigation. Table C-20 summarizes housing density effect on average-day consumption, and maximum-day and maximum-hour load factors for residential and general commercial new growth based on 1995 population estimates.

Table C-20
Change in Current Design Factors Due to Housing Density

	Factor (Percent change from MUD Projections)		
Growth Concept	Average Day Usage	Maximum Day Load Factor	Maximum Hour Load Factor
A	+0.7	+3.2	+3.6
B	-3.2	-6.1	-7.3
C	-4.8	-8.9	-10.4
D	+0.7	-1.2	+1.6

322. The four growth patterns also affect the requirement for expansion of the distribution system. The present worth costs for the four alternative metropolitan area distribution plans are presented in table C-21 in order to indicate the water supply savings which could be realized under Growth Concepts B or C.

Table C-21
Metropolitan Present Worth Comparison
Of Alternative Distribution Plans *
($1,000,000)

Plan	Cost
A	340.09
B	309.51
C	303.02
D	335.64

* Concept B includes the differential present worth costs due to increased population growth for the minor urban areas.

Table C-22
Average Monthly Water Billing ($)

County	Plan I		Plan II		Plan III	
	Concept ACD	B	ACD	B	ACD	B
Washington	22.95	13.95	20.00	10.90	21.00	13.00
Harrison	22.85	18.50	24.75	19.75	24.75	19.85
Pottawattamie	22.60	26.60	25.25	25.25	25.25	25.25
Mills	28.55	19.05	26.10	19.00	27.30	20.40

323. Savings to rural users are realized in Growth Concept B. The increase in population in Washington, Harrison, and Mills Counties results in lower average monthly billings to the users in those counties. The average monthly billings, based on 1995 population projections, are contained in table C-22. Table C-22 indicates that for water supply purposes population dispersion is cost-effective.

Flood Control

324. Flood control alternatives are appropriate for three flood hazard areas in the study region. These areas are the Indian Creek, the Missouri River south of Omaha, and the Papillion Creek system.

INDIAN CREEK AT COUNCIL BLUFFS, IOWA

PLAN DESCRIPTION

325. Three final alternatives were retained for final evaluation. These are one large dam, a system of four small dams, and adoption of flood plain regulations consistent with the flood insurance program. The large dam alternative is similar to the Indian Creek Dam and Reservoir Project which was deauthorized in 1973 due to the inability of the city of Council Bluffs to provide the necessary assurances of local cooperation. A more detailed description of the three alternatives is contained in Volume III - Annex D Flood Control.

CONTRIBUTIONS TO PLANNING OBJECTIVES

326. The planning objectives for this area are:

- To minimize damages caused by floods;

- To reduce the current deficit in outdoor recreation opportunities; and

- To improve water quality.

327. The structural alternatives considered would achieve substantial flood damage reduction. The flood plain management plan, with assumed long-range flood proofing, would provide a damage reduction of only 12 percent over the 100-year economic life. The relative efficiency of the alternatives in meeting the flood control objective is shown in table C-23.

328. The primary contribution of each alternative to the recreation potential of the area is considered to be the amount of open space preserved or made available for outdoor recreation. Cost estimates were based on dry dams with flood control benefits only. The large dam and the 4-dam system would each provide more than 900 acres of open space. The flood plain management alternative does not create significant outdoor recreation opportunities. The relative performance of these alternatives can be seen in table C-23.

329. The dam alternatives would produce a minor improvement in downstream water quality by reducing sediment loads. The effects would be minor compared to the effectiveness of the nearly completed Soil Conservation Service watershed program. In addition,

Table C-23
Summary Comparison of Indian Creek Alternative Plans

Item	I-A Large Dam	IIIA Small Dams	VI-C Flood Plain Management
Plan Description	Dam and reservoir at site of deauthorized Indian Creek Dam and Reservoir	System of 4 small dams upstream from Council Bluffs	Adoption of regulations consistent with Flood Insurance Program
Contribution to Planning Objectives			
a. Minimize flood damages (% reduction)	87	63	12
b. Reduce outdoor recreation opportunity deficit. (Acres recreation available)	992	935	0
c. Improve water quality (Indian Creek)	Minor sediment reduction	Same as 1-A	

the low flow of Indian Creek (20 year average of 1.62 c.f.s.) limits its value as an aquatic resource.

RELTAIONSHIP TO THE FOUR ACCOUNTS

330. Each alternative's relationship to the four accounts is displayed on table C-24.

331. National Economic Development (NED). Beneficial NED effects are the: (1) value of increased output of goods and services resulting from reduced flood damages; and (2) value of output from the use of unemployed labor in construction.

332. National efficiency is increased through the use of labor in construction which would otherwise be unemployed. Labor was assumed to account for one-half of the project costs. It was also assumed that 20 percent of the labor costs would go to the unemployed. This figure derived the payroll to unemployed labor resources in construction of the project.

333. Adverse effects in the NED account include the total annual cost.

334. Net NED benefits are the total monetary benefits minus the total monetary costs. All benefit and cost figures displayed in table C-24 were discounted at an interest rate of 6 1/8 percent and a 100-year economic life.

335. From table C-24, it can be seen that the 4-dam system provides the maximum net benefits and has a benefit to cost ratio of 1.4, followed by the large dam which has a benefit to cost ratio of 1.05. It should be noted that if recreation were included, the benefit to cost ratio for some of the alternatives, including

Table C-24
System of Accounts - Indian Creek Alternatives

Accounts	Footnotes	Large Dam	4 Small Dams	Flood Plain Management
1. National Economic Development				
a. Beneficial Impacts ($1,000)				
(1) Value of increased output of goods and services: Flood control	1,5,7,9	816	595	109
(2) Value of output from use of unemployed or underemployed resources in construction or installation:	1,4,7,10	86	46	0
(3) Total NED Benefits		902	641	109
b. Adverse Impacts ($1,000)				
(1) Project costs	1,5,7,9	860	463	146
(2) Net NED Benefits ($1,000)		42	178	-37
c. B/C Ratio		1.05	1.4	0.8
2. Environmental Quality				
a. Environmental Quality Enhanced: Creation of permanent open space (acres)	1,5,7,9	992	935	0
b. Environmental Quality Destroyed or Degraded: Acres in construction	1,5,7,9	21	72	0

1/ Footnotes indexed at the end of table C-33.

Table C-24
(Cont'd)
System of Accounts - Indian Creek Alternatives

Accounts	Footnotes	Large Dam	4 Small Dams	Flood Plain Management
3. Social Well-Being				
a. Beneficial Impacts				
(1) Enhancement of health, safety, and community well-being: Number of families protected from 100-year flood	1,5,7,9	893	577	0 short term 1,267 long term
(2) Increases in equity of distribution of real income: Reduced average annual damages ($1,000)	3,5,7,9	816	595	109
(3) Educational, cultural, and recreational opportunities: Creation of permanent open space (acres)	2,5,8,9	992	935	0
b. Adverse Impacts				
(1) Deterioration in quality of life, health, and safety: Residual families in 100-yr. flood plain	1,5,7,9	374	690	1,267 short term 0 long term
(2) Injurious displacement of people and community disruption: Displaced families	1,5,7,9	129	22	Numerous building alterations

1/ Footnotes indexed at the end of table C-33.

Table C-24
(Cont'd)
System of Accounts - Indian Creek Alternatives

Accounts	Footnotes	Large Dam	4 Small Dams	Flood Plain Management
4. Regional Development				
a. Beneficial Impacts				
(1) Value of increased income				
Net flood control benefits (annual):				
Flood plain		$816,000	$595,000	$ -37,000
Region		-356,500	-210,500	0
Nation		-417,500	-206,500	0
Total		$ 42,000	$178,000	$ -37,000
(2) Quantity of increased employment				
Jobs created during construction (man-yr.)		453	224	None immediately. Spread over 100-yr. project life
Permanent jobs created for operation and maintenance		2	3	0
(3) Acres in urban area protected from 100-yr. flood and available for higher economic life		788	509	0
b. Adverse Impacts				
Acres removed from local tax rolls		1,013	1,007	0

1/ Footnotes indexed at the end of table C-33.

those previously eliminated, would be increased. Recreation development near a metropolitan area usually returns benefits in excess of costs. The 4-dam system is the preferred NED plan, with the large dam being the second choice.

336. Environmental Quality (EQ). Beneficial effects on the environmental quality (EQ) account are contributions resulting from the management, preservation, or restoration of the environmental characteristics of the area. Due to the proximity to the urban area, the creation of open space is considered a beneficial effect. This open space becomes available for wildlife habitat that would support a number of game and nongame birds and animals. The open space also creates a greenbelt buffer in areas of urbanization.

337. Adverse EQ effects are consequences of the alternatives that result in the deterioration of environmental characteristics in the area. This effect is the amount of land required for actual construction of the project. These EQ effects are noted in table C-24.

338. The large dam and the 4-small dams contribute 992 and 935 acres of open space, respectively. The open space provided by the large dam is situated closer to the urbanized area and is concentrated in a larger block. No open space is preserved by the flood plain management alternative.

339. In view of the foregoing, it appears that the large dam and the 4-dam system can be considered as the EQ plans, with little preference between them at this stage of analysis.

340. <u>Social Well-Being (SWB)</u>. The beneficial SWB impacts are: (1) the enhancement of health, safety, and community well-being; (2) an increase in equity of distribution of real income; and (3) educational, cultural, and recreational opportunities.

341. The first beneficial impact is the enhancement of health, safety, and community well-being as measured by the number of families protected from the 100-year flood. No homes are protected initially by flood plain management. The one large dam alternative provides significantly more protection than the 4-dam alternative.

342. The second beneficial impact is an increase in equity of distribution of real income which is the reduction of average annual damages. The reduction in damages would be, in part, income to families and businesses in the flood plain. The families in the flood plain are primarily low income, therefore this reduction becomes significant. Due to their low income, residents in the flood plain would have difficulty locating acceptable housing elsewhere within their affordable price range. The one large dam alternative provides the largest reduction in flood damages.

343. The third beneficial impact is educational, cultural, and recreational opportunities. Under the single-dam and 4-dam alternatives, the government would purchase a certain number of acres. This land would remain permanent open space in an area undergoing urbanization and would be available for public use. The metropolitan area has been found deficient with regard to recreational lands and opportunities. (See Volume III - Annex E). No open space is preserved by the flood plain management alternative. The dam alternatives are equivalent in their contribution to this portion of the social well-being account.

344. Adverse SWB impacts are: (1) deterioration in the quality of life, health, and safety; and (2) injurious displacement of people and community disruption.

345. The first adverse impact, deterioration of quality of life, health, and safety, affects the families in 100-year flood plain. These are the people who would still be flooded by the 100-year flood under each alternative. The large dam alternative protects a greater number of families and hence fewer families would remain subject to flooding.

346. It should be noted that over the next 100 years, the number of residual families subject to flooding under each alternative would approach zero. This occurence would be due to the gradual replacement of deteriorated dwelling units with new units that conform to flood plain management regulations.

347. The second adverse impact, injurious displacement of people and community disruption, affects the families that would be displaced by each alternative.

348. The large dam alternative requires a significant displacement of families compared to the other alternatives. The magnitude of displacement required by the large dam alternative must be considered a significant plan-decision variable.

349. Loss of food-producing farmland is not a significant factor in the case of Indian Creek. The basin is very steep and wooded. The structural alternates as formulated could be dry dams with no permanent reservoir pool. Therefore impacts on food-producing capabilities should be minor.

350. Regional Development (RD). The regional development (RD) account shown on table C-24 displays the incidence of pertinent beneficial or adverse effects for the flood plain, the region, and the Nation.

351. Beneficial effects due to flood control accrue to the flood plain residents.

352. The value of increased employment is regarded as a gain regardless of where it accrues. Local estimates indicate the construction of the alternatives would have effects on the unemployment rate.

353. The structural alternatives would reduce potential flood areas and would reduce the area subject to flood plain regulation. This would eliminate some potential costs for flood proofing and would lessen the pressure for locating elsewhere outside the city. Council Bluffs is a city faced with rather severe growth constraints. Drainage conditions are very poor in the Missouri River Flood plain west and south of the city. Highly erodable, steep loessial soils exist north and east of the city. Reducing the Indian Creek flood plain will be a significant attribute to the developmental goals of Council Bluffs.

354. Adverse effects (costs) accrue to two regions. The costs of each alternative are divided in accordance with Federal cost-sharing policies. For the structural alternatives, the non-Federal cooperating entity bears the costs of lands and relocations, up to a maximum of 50 percent of the total project cost. For these alternatives, one-half of the investment and amortization charges accrue to the Nation and one-half accrue to the local cooperating body. All

operation and maintenance costs are the responsibility of the local entity. Costs of long-term flood proofing would be the responsibility of those people that live in the flood plain.

355. Net benefits for the flood plain are positive for the alternatives involving dams and negative for flood plain management. Net benefits for the Nation and the region are negative for all alternatives except flood plain management. Negative numbers represent a redistribution of income from the Nation and the local cooperating entity to the flood plain area. If recreation were included, more benefits would accrue to the region and the local cooperating entity.

356. Two employment effects are shown:

- Short-term employment generated in construction of the project. One-half of the construction costs are considered to go to labor. This figure was divided by an assumed average salary to derive the number of jobs generated.

- Long-term employment generated by operation and maintenance. The same method indicated above was used to derive this figure with one-half of the costs assumed to go to labor.

RESPONSE TO ASSOCIATED EVALUATION CRITERIA

357. Acceptability. All of the structural alternatives are objectionable because of local costs. Comments by city officials indicated that they felt a bond issue would have little chance of success. Only about 15 persons, other than Corps personnel, attended the public meeting held in Council Bluffs on 26 June 1975. Part of the lack of interest may be attributed to the interval of 28 years

since the last major flood. Objections were raised to the small dam systems on the grounds that they would interfere with the Soil Conservation Service structures in the Indian Creek basin, which are to be completed this year. There also may be a lack of public understanding about the flood control effectiveness of the Soil Conservation Service structures which are primarily for grade stabilization.

358. Sensitivity. A characteristic of all the alternatives is that the flood control benefits are very sensitive to assumed channel capacities. Channel sediment and obstructions can greatly affect the degree of flooding. Factors adding to the uncertainty are the hydraulic complexities resulting from a combination of open and covered channels and over-bank conditions varying from a steep, narrow valley to a delta formation, to a nearly flat flood plain.

359. Effectiveness. A review of table C-24 indicates that the large dam is more effective in terms of reducing flood damages and flood area than the 4-dam alternative. The flood plain management alternative provides no immediate effectiveness in reducing flood damages.

360. NED Benefit-Cost Ratio. Only flood control and employment benefits were evaluated. If recreation benefits were included, those alternatives offering recreation opportunities would have higher benefit-cost ratios. The 4-dam system had the highest benefit to cost ratio.

361. Geographic Scope. The flood control benefits of these alternatives are essentially localized to the city of Council Bluffs. Recreation benefits can be considered to apply to the metropolitan

area. Except for flood plain management, the land required for the projects would lie outside of the city in Pottawattamie County.

SIGNIFICANT IMPACTS SPECIFIED IN SECTION 122 of P.L. 91-611

362. Economic Impacts. Economic impacts specified are:

Tax revenues

Property values

Public facilities

Public services

(Desirable) regional growth

Employment/labor force

Business and industrial activity

Displacement of farms

363. The tax revenues lost would be in relation to the acres of land required for each alternative. The lands required are shown in table C-24. For the structural alternatives requiring large amounts of land, the areas lost would be suburban or rural outside of the city.

364. Property values in the flood plain would improve with increased flood protection.

365. Public facilities and services would be benefited by flood control. Their principal impacts can be accounted for in project costs and flood control benefits.

ENVIRONMENTAL IMPACTS

366. The alternatives discussed are not expected to alter the growth rate of the area. The preservation of open space near the urban area, as displayed in table C-24, should be socially and environmentally desirable.

367. The effects on employment have been tabulated in table C-24 under regional development.

368. Business and industrial activity would be benefited by a decrease in flood damages and the lessening or elimination of flood plain restrictions. Flood plain management may influence some decisions to locate in the outer parts of the city away from the flood plain in the downtown area.

369. A few farmsteads would be displaced by the alternatives which involve dams. None would be displaced by flood plain management. The discussion of adverse impacts on the social well-being account considers loss of farmland.

MISSOURI RIVER

370. Two levee units along the Missouri River are included as part of the final water resource plans for the region. Planning for these levee units is being conducted in coordination with, but not as a part of, the urban study. Therefore a Principals and

Standards display was not prepared for these levee units. The main impacts of the levees are summarized below.

371. Levee Units L-611 and L-614 would be located on the left bank of the Missouri River immediately downstream of the city of Council Bluffs, Iowa. These levees would protect approximately 24,800 acres of land primarily used for agriculture. July 1974 estimated project costs were $5,710,000, with a benefit to cost ratio of 3.43 to 1 using the authorized interest rate of 2.5 percent. A current (December 1975) evaluation indicates a project cost of $10,537,000, with a benefit to cost ratio of 4.2 using a 2.5 percent interest rate, and a benefit to cost ratio of 1.9 using a 6.125 percent interest rate.

372. The levee units are not expected to create any significant environmental impacts. A discussion of the environmental impacts can be found in the Draft Environmental Impact Statement dated November 1974. The public generally strongly supports construction of these levee units which have a local sponsor. Benefits to future land uses were not used in any of the economic analysis. Units L-611-614 are economically justified without the addition of futures benefits. Implementation of the levee units will aid in implementation of the Missouri Riverfront Corridor Land Use Plan; in particular the levees will aid a proposed industrial area in Mills County.

373. Proposed Missouri River Levee Unit R-616 would be located immediately south of Bellevue, Nebraska. This unit would protect approximately 3,920 acres of predominately agricultural land. Other land uses include residential, commercial, transportation, sewage treatment, and recreation.

374. July 1974 estimated project costs were $1,150,000, with a benefit to cost ratio of 5.05 to 1 using the authorized interest rate of 2.5 percent. A current (December 1975) evaluation is underway to reflect current conditions and values. Preliminary indications are that the project will remain economically justified.

375. Unit R-616 is not expected to create any significant environmental impacts. A discussion of the environmental impacts can be found in the Draft Environmental Impact Statement dated February, 1975.

376. While Unit R-616 has a local sponsor, there is some public opposition to the project. The opposition is centered among seasonal and permanent residents who would be located on the riverward side of the levee. The opponents concern is that both L-611-614 and R-616 would raise flood depths in their area. Construction of the levee units would not, however, appreciably affect flood stages in the area.

377. The implementation of Unit R-616 can have some positive effects on regional development. The area that would be protected by R-616 is projected for possible future industrial usage in the Missouri Riverfront Corridor Land Use Plan.

378. The remaining flood problem in the Missouri River flood plain within the study area is considered minor. Additional structural solutions other than those mentioned above were not found to be economically justified.

379. The Omaha District, Corps of Engineers currently is performing a Missouri River floodway study. This study will show flood

profiles relative to the streambank and streambed. The flood profiles will provide a suitable basis for the adoption of flood plain land use controls.

380. Since additional structural measures were found infeasible, it was concluded that flood plain zoning is the best alternative for the flood hazard areas other than those that would be protected by Units L-611-614 and R-616. There is current interest in developing the Missouri River flood plain as evidenced by the Missouri Riverfront Development Program and Corridor Land Use Plan. Delineation of flood hazard areas and flood frequencies by the Omaha District's floodway study will greatly aid land use planning in the riverfront area.

PAPILLION CREEK LAKES PROJECT

381. The authorized Papillion Creek Lakes Project was reevaluated in parallel and as a part of the Omaha urban study. The authorized project consisted of 21 dams and reservoirs on tributaties of Papillion Creek. The reevaluation was required because of rising investment costs and the effects of the Flood Disaster Protection Act of 1973, Public Law 93-234.

382. For the purposes of the reevaluation, the Papillion Creek basin was divided into its three natural drainages of the Little Papillion Creek, West Branch Papillion Creek, and Big Papillion Creek. A more detailed description of the reevaluation is contained in the Papillion Creek and Tributaries Lakes, Nebraska Plan Evaluation Report dated September 1975.

LITTLE PAPILLION CREEK

383. The plan for Little Papillion Creek includes Dams 10 and 11, the completed Little Papillion Creek channel improvement project, and flood plain regulation. In combination, these elements would provide 100-year or greater protection between the damsites and the mouth of Little Papillion Creek. Dams 10 and 11 would cause minor flood peak reductions on Papillion Creek from the mouth of Little Papillion Creek downstream to the West Branch; downstream from the West Branch, their effect would be negligible. The Little Papillion Creek basin is hydrologically separate and distinct and is, therefore, not affected by improvements made on Big Papillion Creek and West Branch Papillion Creek. Dam 11 will begin to store water in 1976 and Dam 10 still in the planning stage, is the last structural element of the plan.

384. The Phase I General Design Memorandum for Dam 10 was completed in October 1973. It reaffirmed the need for flood control, recreation, and low flow releases to improve esthetics in the downstream channel and it reaffirmed the opportunity for fish and wildlife management. It also reaffirmed that there are no viable alternatives to the authorized plan on Little Papillion Creek because of the intense existing development in the Little Papillion Creek flood plain.

385. The current flood damage appraisal on the Little Papillion Creek shows that Dam 10 would reduce the average annual damage potential in the Little and Big Papillion Creek basins from $292,000 and $1,305,000, respectively to $182,500 and $1,217,000, respectively. Average annual flood control benefits attributable to Dam 10 are $197,500 under existing conditions of development.

Dam 10 is economically justified under existing conditions for flood control only or for multi-purpose development. Since benefits based on future levels of development are not required for justification and since the flood plain is extensively developed, no estimate of future benefits was made. A summary of average annual benefits for Dam 10 is as follows:

Flood Control	
Existing Conditions	$197,500
Recreation	
General	84,000
Fish and Wildlife	7,900
Water Quality	1,400
Total Average Annual Benefits	$290,800

386. Based on a first cost of $3,600,000 (October 1975 price levels), a summary of annual costs, based on an interest rate of 3.25 percent, is as follows:

Interest and Amortization	$122,000
Operation, Maintenance, and Replacement	43,000
Total Annual Costs	$165,000

387. Table C-25 is an economic summary for Dam 10. A cost allocation using the separable costs-remaining benefits method shows that 78.0 percent of the first costs are allocated to flood control, 21.7 percent to recreation, and 0.3 percent to water quality.

388. Because Dam 10 is the last remaining structural element of the Little Papillion Creek portion of the authorized plan, and it meets all the tests of economic feasibility, and because the Little Papillion Creek basin is hydrologically separate and distinct and,

therefore, not affected by improvements on Big Papillion and West Branch Papillion Creeks, the Plan Evaluation Report recommended that construction of Dam 10 should proceed as soon as possible.

Table C-25
Economic Summary
Dam 10

	Flood Control Only	Multi-purpose Development
Costs		
Total investment cost	$3,290,000	$3,600,000
Average annual cost	128,400	165,000
Benefits (average annual)	197,500	290,800
B/C Ratio		
Existing conditions	1.6	1.8

WEST BRANCH PAPILLION CREEK

389. The authorized project includes eight dams on the West Branch. At the time of authorization, these eight dams had a cost of $10,559,000. Based on October 1975 price levels, the first cost has increased to $48,700,000. Rapidly rising construction costs and extremely rapid increases in land costs due to the close proximity of the damsites to Omaha have been the main reasons for this increase.

390. The eight dams currently have an average annual cost of $1,500,000 for flood control only and $2,400,000 for multi-purpose development. Considering the changes in flood plain regulation and the current first costs, a preliminary analysis shows that the average annual costs exceed the average annual benefits to existing development by more than 6 to 1. Future flood control benefits and

recreational benefits would be required to justify the authorized project. Accordingly, a full scale reformulation of this element of the authorized plan was recommended by the Plan Evaluation Report. The reformulation will recognize the problems as they exist, their probable future magnitude, and will include a full evaluation of alternative solutions. The evaluation of alternative solutions will include the potential for scaling of the authorized project and the relative merits of non-structural measures.

391. There is great public concern and support for flood control measures along the West Branch Papillion Creek. Local officials feel that any substantial modifications of the authorized project for the West Branch would represent a breach of faith by the Corps of Engineers. The officials feel that their county (Sarpy) is being penalized because they took action to restrict development in the flood plain. This restriction of development affects futures benefits and the economic feasibility of the authorized projects for the West Branch Papillion Creek.

BIG PAPILLION CREEK

392. Two iterations of the reformulation of the authorized plan for the Big Papillion Creek basin will be discussed below.

393. Previous studies have consistently shown that the most effective solution to flood problems in the Big Papillion Creek flood plain consists of complete regulation by reservoirs located just upstream from Blondo Street. Existing roads, railroads, and other improvements however preclude the construction of a dam this far downstream. Extensive investigations of many alternative damsites in previous studies resulted in the conclusion that optimum protection

would be provided by construction of 11 dams. Thus Dams 1-9 and Dams 16 and 17 were authorized by Congress. A development corporation constructed a dam on the site selected for Dam 17, consequently this unit of the Corps' plan was dropped. Except for recreation developments, construction of Dam 16 is complete; therefore, only Dams 1-9 were looked at in the Plan Evaluation Report.

394. Three different factors influenced the review of the authorized project in the Big Papillion Creek basin. First, reduced expected future benefits because of recently enacted flood plain land use regulations and increased costs make Dams 5 through 9 economically infeasible. Secondly, recent abandonment of the railroad line which parallels Big Papillion Creek downstream from Dam 3 allowed consideration of Dam 3 at a new location approximately 2.5 miles farther downstream. This new site for Dam 3 was labeled Dam 3A. Thirdly, local interests requested that dry dams and channel improvements be evaluated and compared to the authorized plan. Therefore, the review consisted of evaluating the feasibility and advisability of modifying the authorized project by eliminating some of the dams, or by reconfiguration with Dam 3 at a downstream site and consideration of other structural and non-structural alternatives.

395. The main evaluation factor for the initial iteration was each alternative's effectiveness and economic efficiency in reducing the flood threat. Flood control benefit and cost data for the initial alternatives are displayed in table C-26.

396. Because there is a significant deficiency in recreation opportunities in the study area, each alternative's contribution to recreation was also determined. Water quality enhancement, although

Table C-26
Big Papillion Creek
Benefit and Cost Data for Flood Control Only

Alternative	Investment	Existing Conditions Annual Costs	Existing Conditions Annual Benefits	Existing Conditions Benefit-Cost Ratio	Future Conditions Annual Benefits	Future Conditions Benefit-Cost Ratio
Dams 1-3	$20,700,000	$ 776,000	$ 855,000	1.1	$1,600,000	2.1
Dams 1-4	24,800,000	935,000	924,000	1.0	1,700,000	1.8
Dams 1-9 (Authorized Project)	39,100,000	1,500,000	1,049,000	0.7	1,900,000	1.3
Dam 3A	25,600,000	917,000	1,037,000	1.1	1,822,000	2.0
Channel (Q St. to Blondo) 100-year	22,100,000	828,000	725,000	0.9	725,000	0.9
Levee (Q St. to Blondo)						
100-year	27,500,000	1,010,000	750,000	0.7	750,000	0.7
SPF	33,700,000	1,200,000	810,000	0.7	810,000	0.7
Evacuation 100-Year Flood Plain	78,000,000	2,643,000	760,000	0.3	760,000	0.3

a very minor benefit, was also evaluated. The multi-purpose alternatives are the only ones capable of contributing to recreation and water quality. Benefit and cost data for the multi-purpose alternatives are displayed on table C-27.

Table C-27
Big Papillion Creek
Benefit and Cost Data for Flood Control, Recreation, and Water Quality

Alternative	Investment	Annual Costs	Existing Conditions: Annual Benefits	Existing Conditions: Benefit-Cost Ratio	Future Conditions: Annual Benefits	Future Conditions: Benefit-Cost Ratio
Dams 1-3	$27,700,000	$1,483,500	$2,561,000	1.7	$3,300,000	2.2
Dams 1-4	33,200,000	1,765,800	2,930,000	1.7	3,706,000	2.1
Dams 1-9 (Authorized Project)	49,400,000	2,727,000	3,255,000	1.2	4,100,000	1.5
Dam 3A	32,500,000	1,616,100	2,806,000	1.7	3,591,000	2.2

397. The social and environmental effects of each initial alternative were also evaluated. A discussion of these effects is contained in the September 1975 Plan Evaluation Report.

398. It is apparent from tables C-26 and C-27 that none of the alternatives except modification of the authorized project warranted further consideration.

399. Dam 4, 5, 6, 7, 8, or 9 would not be economically justified as first added to Dam 16 or as next added to Dams 1, 2, and 3 as a single-purpose flood control project. Therefore, Dams 1, 2, and 3 represent the economically optimum portion of the authorized project for single-purpose flood control.

400. When recreation and water quality were included in the evaluation, Dam 4 would be incrementally justified as first added to Dam 16 or as next added to Dams 1, 2, and 3. Dams 5 through 9 however, would not be incrementally justified as first added to Dam 16 or as next added to Dams 1, 2, 3, and 4 as multiple-purpose projects. Therefore, Dams 1 through 4 represent the optimum portion of the authorized multiple-purpose project.

401. Dam 3A would be economically feasible as a multiple-purpose dam or as a single-purpose dam for flood control only.

402. Based on the above, two modifications of the authorized project were carried forward for final evaluation. These modifications are construction of Dams 1 through 4 of the authorized 9-dam system and the construction of Dam 3A in place of the authorized 9-dam system. These two alternatives were compared

and evaluated in accordance with the Principles and Standards.

403. Each alternative was compared with respect to its contribution to the planning objectives, its relationship to national economic development, environmental quality, social well-being, and regional development accounts, and its response to associated evaluation criteria.

PLAN DESCRIPTIONS

404. The two alternatives would be multiple purpose in that they would provide flood control benefits, permanent pools, and project lands for recreation use; would release minimum flows to improve water quality and esthetics downstream; and provide lands for management of fish and wildlife. Either alternative could be constructed as "dry dams." In that case, there would be no permanent pool or project land available for recreation and no storage for water quality releases. Rather, the area of the reservoir below the 10-year pool would be allocated to wildlife management and the remainder of the reservoir land would be used for crop production. The prevailing difference between "dry dams" and multiple-purpose dams is that recreation and water quality benefits of the multiple-purpose project are foregone for agricultural production with "dry dams".

405. Since there is little difference in the flood control costs and benefits for either dry dams or multiple-purpose dams, the significant comparison is between the net economic output of recreation and water quality with multiple-purpose dams and the net economic output of agriculture with "dry dams." For Dams 1 through 4 or Dam 3A, the net output from agriculture would be less than one-sixth the net output from recreation and water

quality. This would result in "dry dams" having a benefit-to-cost ratio about 20 percent less than multiple-purpose dams.

406. Since "dry dams" would have a lower benefit-to-cost ratio, they would not provide recreation opportunities for this region which is critically short of such opportunities, and would have other impacts similar to their multiple-purpose counterparts, they are not considered further in this review. Dams 1 through 4 and Dam 3A are further compared and evaluated as multiple-purpose alternatives.

407. Dams 1 through 4 would control runoff from approximately 87 square miles. Reservoir operation would require 6,073 acres of land and an additional 1,177 acres would be acquired for recreational development. Permanent pools for recreational use at the four dams would total 1,695 acres. Dam 3A would control runoff from approximately 106 square miles. Reservoir operation would require 4,150 acres of land and an additional 1,000 acres would be acquired for recreation development. A permanent pool of 1,500 acres would be available for recreational use.

CONTRIBUTIONS TO PLANNING OBJECTIVES

408. The four planning objectives include flood control, recreation, fish and wildlife management, and water quality.

409. Average annual flood damages are currently about $1.3 million. Dam 3A would reduce these damages by $1,037,000 and would reduce costs and damages of future flood plain development by $785,000. Dams 1 through 4 would reduce damages to existing

development by $924,000 and would reduce damages and costs of future flood plain development by $776,000.

410. The Nebraska State Comprehensive Outdoor Recreation Plan defines critical deficiencies in regional opportunities for outdoor recreation. Dam 3A would reduce the current deficit in land needed for these activities by 13 percent and water needed for these activities by 8 percent. Dams 1 through 4 would reduce the current land deficit by 20 percent and water deficit by 9 percent.

411. The region is experiencing both intensive cropping and rapid suburban development. As a result, wildlife habitat is rapidly diminishing. One thousand acres of Dam 3A project lands and 2,424 acres of the project lands of Dams 1 through 4 would be allocated to wildlife management.

412. Flows in Big Papillion Creek are often reduced to zero by dry weather. At such times, stagnant pools promote mosquito reproduction, produce odors, and reduce esthetic values. Dam 3A and Dams 1 through 4 would provide flows of 3 cubic feet per second downstream from the damsites during non-winter months.

RELATIONSHIP TO FOUR ACCOUNTS

413. Beneficial and adverse impacts of each of the two alternatives are presented in detail in table C-28 in four accounts, National Economic Development (NED), Environmental Quality (EQ), Social Well-Being (SWB), and Regional Development (RD).

Table C-28

System of Accounts - Big Papillion Creek Alternat

Accounts	Footnotes	Dams 1-4	Dams 3A
1. National Economic Development			
a. Beneficial impacts			
(1) Value of Increased Output of goods and services.			
Flood Control	3,5,9	$1,700,000	$1,822,000
Recreation	2,5,9	1,676,000	1,493,000
Fish and Wildlife	2,5,9	324,000	270,000
Water Quality	2,5,9	6,000	6,000
(2) Total NED benefits		$3,706,000	$3,591,000
b. Adverse Impacts			
(1) Project Costs			
Int. and Amortiz.	1,5,9	$1,124,800	$1,101,100
O, M, and R	2,5,9	641,000	515,000
(2) Total NED Costs		$1,765,800	$1,616,100
c. Net NED Benefits		$1,940,200	$1,974,900
B/C Ratio		2.1	2.2
2. Environmental Quality			
a. Environmental quality enhanced			
Wildlife acres	*2,6,9	2424	1000
Water surface acres	*2,6,9	1695	1500
Improved aesthetics	*2,6,9	4 lakes	large lake
Minimum stream flow	*2,6,7,9	3 c.f.s.	3 c.f.s.
b. Environmental quality degraded			
Degraded aesthetics	*2,5,9	mudflats	mudflats
c. Environmental quality destroyed			
Natural channel inundated (miles)	*2,5,9	20	10
Good wooded cover		3	1
Good grassy cover		11	5
Poor habit		6	4
3. Social Well-Being			
a. Beneficial impacts			
(1) Enhancement of quality of life, health & safety.			
Families protected from 100-year or greater flood.	*2,5,9	600	600
(2) Educational, cultural, and recreation opportunities.			
Acres provided (present deficit)			
Picnicing (4087 acres)	2,5,7,9	129	95
Camping (599 acres)		74	75
Fishing (6303 acres)		1695	1500
Swimming (15 acres)		3	2
Boating (8082 acres)		1695	1200
Waterskiing (4380 acres)		1172	900
Miles of hiking trails provided (25 mi.)		28	22
Recreation days provided	2,5,7,9	1,333,000	1,175,000
b. Adverse Impacts			
Injurious displacement of people & community disruption.			
Displaced Farm Families		46	17
Displaced Urban Families		0	19
Displaced Total Families	*1,6,8,9	46	36
Reduced Cropland (acres)	*1,5,9	6100	4300

Accounts (continued)	Footnotes	Dams 1-4	Dams 3A
4. Regional Development			
a. Beneficial impacts			
(1) Value of increased income.			
Net Benefits:			
Flood Plain	2,5,7,9	$1,700,000	$1,822,000
Region	2,5,7,9	1,307,700	1,181,100
Nation	2,5,7,9	-1,067,500	-1,028,200
Total	2,5,7,9	1,940,200	1,974,900
(2) Quantity of increased employment.			
Jobs created during construction (man yrs.)	*1,5,9	600	700
Jobs created for operation & maintenance	*2,5,9	4	4
(3) Desirable population distribution.	*2,4,10	not quantified	
(4) Increased stability of regional economic growth.	*2,4,10	not quantified	
b. Adverse impacts.			
(1) Undesirable population distribution.	*2,4,10	not quantified	
(2) Decreased stability of regional economic growth.			
Business reduction	*2,4,10	not quantified	
(3) Property tax			
Washington County			
Acres removed	*1,5,9	7250	2995
Assessed value loss	*1,5,9	$1,018,000	$ 428,000
percent		1.5	0.6
Mill levy adjustment		0.1	0.05
Douglas County			
Acres removed	*1,5,9	0	0
Assessed value loss	*1,5,9	0	$ 197,000
percent		0	0.002
Mill levy adjustment	*1,4,10	0	0.0003
Kennard Fire District			
Acres removed	*1,5,9	5889	2920
Assessed value loss	*1,5,9	$ 766,000	$ 365,000
percent		10.5	5.0
Mill levy adjustment	*1,4,10	0.2	0.07
Arlington Fire District			
Acres removed	*1,5,9	111	0
Assessed value loss	*1,5,9	$ 16,000	0
percent		0.2	0
Mill levy adjustment	*1,4,10	0.002	0
Blair Fire District			
Acres removed	*1,5,9	321	0
Assessed value loss	*1,5,9	$ 36,000	0
percent		0.3	0
Mill levy adjustment	*1,4,10	0.001	0
Bennington Fire District 1/			
Acres removed	*1,5,9	929	2230
Assessed value loss	*1,5,9	$ 200,000	$ 260,000
percent		3.8	5.0
Mill levy adjustment	*1,4,10	0.04	0.05

1/ Does not include $198,000 assessed value loss due to Dam 16 & 10.

2/ Does not include $84,000 assessed value loss due to Dam 10.

Table C-28
System of Accounts - Big Papillion Creek Alternatives

Accounts (continued)	Footnotes	Dams 1-4	Dams 3A
4. Regional Development			
a. Beneficial impacts			
(1) Value of increased income.			
Net Benefits:			
Flood Plain	2,5,7,9	$1,700,000	$1,822,000
Region	2,5,7,9	1,307,700	1,181,100
Nation	2,5,7,9	-1,067,500	-1,028,200
Total	2,5,7,9	1,940,200	1,974,900
(2) Quantity of increased employment.			
Jobs created during construction (man yrs.)	*1,5,9	600	700
Jobs created for operation & maintenance	*2,5,9	4	4
(3) Desirable population distribution.	*2,4,10	not quantified	
(4) Increased stability of regional economic growth.	*2,4,10	not quantified	
b. Adverse impacts.			
(1) Undesirable population distribution.	*2,4,10	not quantified	
(2) Decreased stability of regional economic growth.			
Business reduction	*2,4,10	not quantified	
(3) Property tax			
Washington County			
Acres removed	*1,5,9	7250	2995
Assessed value loss	*1,5,9	$1,018,000	$ 428,000
percent		1.5	0.6
Mill levy adjustment		0.1	0.05
Douglas County			
Acres removed	*1,5,9	0	0
Assessed value loss	*1,5,9	0	$ 197,000
percent		0	0.002
Mill levy adjustment	*1,4,10	0	0.0003
Kennard Fire District			
Acres removed	*1,5,9	5889	2920
Assessed value loss	*1,5,9	$ 766,000	$ 365,000
percent		10.5	5.0
Mill levy adjustment	*1,4,10	0.2	0.07
Arlington Fire District			
Acres removed	*1,5,9	111	0
Assessed value loss	*1,5,9	$ 16,000	0
percent		0.2	0
Mill levy adjustment	*1,4,10	0.002	0
Blair Fire District			
Acres removed	*1,5,9	321	0
Assessed value loss	*1,5,9	$ 36,000	0
percent		0.3	0
Mill levy adjustment	*1,4,10	0.001	0
Bennington Fire District 1/			
Acres removed	*1,5,9	929	2230
Assessed value loss	*1,5,9	$ 200,000	$ 260,000
percent		3.8	5.0
Mill levy adjustment	*1,4,10	0.04	0.05

1/ Does not include $198,000 assessed value loss due to Dam 16 & 10.

2/ Does not include $84,000 assessed value loss due to Dam 10.

Accounts (continued)	Footnotes	Dams 1-4	Dam 3A
Washington County School District #1			
Acres removed	*1,5,9	2985	783
Assessed value loss	*1,5,9	$ 467,000	$ 97,000
percent		3.2	0.7
Mill levy adjustment	*1,4,10	2.3	0.5
Washington County School District #24			
Acres removed	*1,5,9	1678	309
Assessed value loss	*1,5,9	$ 228,000	$ 35,000
percent		1.8	0.3
Mill levy adjustment	*1,4,10	0.9	0.1
Washington County School District #32			
Acres removed	*1,5,9	543	0
Assessed value loss	*1,5,9	$ 67,000	0
percent		6.9	0
Mill levy adjustment	*1,4,10	1.0	0
Washington County School District #R100			
Acres removed	*1,5,9	2044	2462
Assessed value loss	*1,5,9	$ 256,000	$ 296,000
percent		15.7	18.2
Mill levy adjustment	*1,4,10	3.9	4.7
Douglas County School 2/ District #59			
Acres removed	*1,5,9	0	1596
Assessed value loss	*1,5,9	0	$ 197,000
percent		0	3.7
Mill levy adjustment	*1,4,10	0	1.0
Douglas County School District #8			
Acres removed	*1,5,9	0	0
Assessed value loss	*1,5,9	0	0
percent		0	0
Mill levy adjustment	*1,4,10	0	0

Index of Footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation).

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

Section 122

* Items specifically required in Section 122 and ER 1105-2-105.

414. National Economic Development Account (NED). All NED computations assume a discount rate of 3.25 percent and a 100-year project life. Future benefits are included.

415. Beneficial impacts in the NED account result from reduced flood damages, provision of recreation opportunities for which there is a great demand, provision of fish and wildlife benefits, and improved downstream water quality in the Big Papillion Creek.

416. Adverse impacts in the NED account include the amortized construction cost and the annual cost of operation, maintenance, and replacement.

417. Dam 3A would provide annual excess benefits of $1,974,900 and a benefit-to-cost ratio of 2.2. Dams 1 through 4 would provide total annual excess benefits of $1,940,200 and a benefit-to-cost ratio of 2.1. Both alternatives are, therefore, comparable in terms of NED plans.

418. Environmental Quality Account (EQ). EQ enhancement includes provision of wildlife lands, water surface, fish habitat, and improved esthetics.

419. EQ degradation includes reduced esthetic value resulting from mudflats.

420. EQ destruction results from the inundation or renovation of natural channels. Most of the land in the upstream part of the basin is devoted to agriculture. Therefore, natural wildlife

habitat is primarily located along the watercourses. The number of miles of channel that would be inundated is divided into three categories of wildlife habitat: good wooded habitat, good grassy habitat, and poor habitat. Dam 3A, and Dams 1 through 4 would inundate significant amounts of good wildlife habitat. Native minnow and small aquatic animal populations would not be adversely affected by inundation. The channel reaches farther upstream would develop into marshes. These would be of greater benefit to fish and wildlife habitat than the existing channels. It is expected that existing tree areas located upstream would develop into marshes. These would also be of greater benefit as fish and wildlife habitat than the existing channels. It is expected that the existing trees located upstream would occupy larger areas due to natural production and reduced agricultural pressures. Minor periodic flooding would not harm this process; however, a major storm could seriously harm this process by killing parent stock through silt deposition.

421. Social Well-Being (SWB). Beneficial SWB impacts include the improved safety of families protected from 100-year and greater floods and the recreation days provided. Currently 600 families reside in the 100-year flood plain. It is assumed that no additional families would move into the 100-year flood plain without the project. Flood insurance and flood proofing costs would be eliminated and threat of injury or loss of life, economic losses, and post-flood trauma would be reduced to 1 percent or less annual probability for all 600 families with either alternative.

422. Dam 3A and Dams 1 through 4 would significantly increase the boating, waterskiing, and fishing opportunities of the region. Both alternatives would also meet a substantial percentage of the projected needs for picnicking, camping, swimming, and hiking. Dam 3A and Dams 1 through 4 would provide 8 and 9 percent respectively of the 18,780 acres of water and 13 and 20 percent respectively of the 27,717 acres of land currently defined as deficits in the region. Dams 1 through 4 and Dam 3A would provide 1,333,000 and 1,175,000 annual recreation days respectively.

423. Adverse impacts include displaced families and businesses and the reduction in cropland. Displacement is considered the most significant adverse effect on social well-being. Displacement affects the families involved and the community in which they reside. Many of the farms in this area have been farmed by the same family for generations. The relocation assistance provided under Public Law 91-646 provides for the economic aspects of relocation; however, many social stresses incurred by relocation are non-quantifiable. The number of families displaced is used as a measurement of this effect.

424. Since 1964, available cropland in Washington and Douglas Counties has diminished at the rate of 2,200 acres per year. If urban growth continues as presented in the 1990 Washington County Land Use Plan and the 1995 Metropolitan Area Planning Agency Land Use Plan, cropland will diminish at the rate of 3,500 acres per year through the 1900's. Therefore, much of the land required by the alternatives is likely to be developed during the next two or three decades. The 5,150 acres of land required for Dam 3A includes 4,300 acres of cropland which would

be the equivalent of 1.5 to 2 years normal reduction in cropland. Similarly, Dams 1 through 4 would require 7,250 acres including 6,100 acres of cropland which corresponds to the normal reduction expected to occur over a 2- to 3-year period.

425. Regional Development Account (RD). Implementation of either of the alternatives would create changes in the region's income, employment, population distribution, and economic base which in turn would influence the course and direction of the development of the region. Beneficial impacts include redistribution of income from the Nation to the region, increased regional employment, improved population distribution, and improvement in the economic base of a few small communities. Adverse impacts consist of increased potential for undesirable population growth and deterioration of the economic base in localized areas caused by the relocation of farm customers and the removal of land from local taxing districts.

426. Income redistribution would result from the incidence of the benefits and costs of each alternative between the Nation, the region, and the flood plain. Flood control benefits would accrue to the flood plain. Recreation benefits would accrue to the region. Water quality benefits would accrue to the Nation. The costs of each alternative are divided between the region and the Nation in accordance with Federal cost-sharing policies. The region is the non-Federal cooperating body which could be the State of Nebraska, a county, the Papio Natural Resources District, or a municipality. For both alternatives, the Nation would pay all flood control and water quality costs. Costs allocated to recreation would be divided equally between the

Nation and the region. Operation, maintenance, and replacement costs for recreation would be borne by the region. Net NED benefits would be positive for the flood plain and the region and negative for the Nation with either alternative. This would represent a redistribution of income from the Nation to the flood plain and the region.

427. Regional employment would be increased a total of four jobs for the life of the project for operation and maintenance and 700 and 600 man-years during construction for Dam 3A and Dams 1 through 4 respectively. In addition to employment created by construction, operation, and maintenance, the recreation developments would provide employment opportunities in concessions and bait shops, restaurants, supply stores, and gasoline stations in communities near the lakes.

428. Population dispersal could be positively affected by residential attractiveness of either alternative. Although these alternatives in themselves would not significantly affect the population distribution of the region, they could be effective in the implementation of regional land use plans. For example, the creation of a regional growth center at Bennington or Kennard would be enhanced by the existence of Dam 3A or Dams 1 through 4 which would be consistent with Growth Concept B.

429. The economic base of the entire region would not be significantly affected by either of the alternatives. However, some of the small communities near Dam 3A and Dams 1 through 4 would be affected. Blair, Arlington, Fort Calhoun, Valley, Waterloo, and Elkhorn are too distant from any site to be affected. Bennington

is adjacent to Dam 3A; therefore, it could be affected. The changes caused by implementing either alternative, however, are considered minimal compared to the current changes occurring in Bennington as it develops into a "bedroom" community for Omaha. Recently developed subdivisions are already larger than the original community.

430. Washington and Kennard would be significantly affected by implementation of either alternative through business from recreation visitors and residential development influenced by the lakes. Because Kennard is served by a better transportation system, the effects on Kennard would be greater than on Washington. Increases could be expected in the sales of gasoline, food, beverages, and fishing, boating, and camping supplies. In addition, new businesses such as bait shops, restaurants, and recreational equipment sales would likely be established. These expanded and new businesses would diversify the economic base of these communities making them less subject to business declines as farmers move out of the area and less subject to the cyclic nature of the agricultural economy.

431. Adverse population growth could result with either alternative. Residential development encouraged by the lakes could result in inefficient and uncontrolled urban sprawl if effective land use controls are not implemented in the region. This occurrence would be consistent with Growth Concepts A or D.

432. Adverse impacts on the economic base on Kennard and Washington caused by displacement of families and reduction of cropland could result from construction of either Dam 3A or Dams 1 through 4. However, not all displaced families would be

expected to leave the area. In a study of the effects of Branched Oak Lake near Lincoln, Nebraska, it was found that 67 percent of the displaced farm owner operators remained in the area even though they did not necessarily reinvest in farm real estate. Business loss resulting from reduced crop production would occur but is expected to be small compared to the normal changes in the market patterns of farmers. The Branched Oak Lake study found that farmers' decisions to patronize different firms for their grain, fertilizer, feed, seed, and petroleum affected local firms more than the construction of the lake. Since business patterns would readjust in a short time, these impacts would create minor, short-term effects.

433. Land purchased by the Federal Government would not be subjective to local taxes. The direct impact of either altenative would be a reduction in the assessed value in individual school districts, fire districts, and counties. The reduction in assessed value would result in a loss of revenue for the taxing entities. The tax loss effects on the two counties involved would be insignificant. Since 1962, property tax collected in Washington County has increased nearly 7 percent per year. Dams 1 through 4, the alternative with the greatest effect, would reduce this increase to 5 percent for 1 year if all land were purchased within a year. Since 1962, property tax collected in Douglas County has increased nearly 9 percent per year. Neither alternative would significantly affect this rate of increase.

434. Tax losses to individual school districts and fire districts are displayed in table C-28. Dam 3A would result in a total loss of assessed value of $625,000 while Dams 1 through 4 would result in a $1,018,000 loss.

435. Federal aid is available to school districts impacted by Federal projects under Public Law 81-874. The law provides that, along with other stipulations, school districts are eligible for aid if 10 percent or more of the assessed value of all real property in the district is removed from the tax rolls. The impact on school districts could also be diminished by consolidation of adjacent districts.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

436. The two most significant associated evaluation criteria are the Federal interest test and public acceptability.

437. Criteria for determining the Federal interest is that the NED benefits must be greater than the costs and the benefit-to-cost ratio should be maximized. Therefore, the Federal interest is best served by an alternative that provides the highest benefit-to-cost ratio. Dam 3A would provide a benefit-to-cost ratio of 2.2 while Dams 1 through 4 offer a lower benefit-to-cost ratio of 2.1.

438. Public acceptability is essentially equal for either alternative. Downstream interests mainly in the city of Omaha and Sarpy County and fish and wildlife interests have expressed support for either alternative. Upstream interests, mainly in upper Douglas and Washington Counties oppose both alternatives.

PLAN SELECTION

439. The Plan Evaluation Report recommended that Dam 3A be constructed rather than Dams 1 through 4 because Dam 3A would provide a reduction in average annual flood damages of more than $1.8 million compared to $1.7 million for Dams 1 through 4. Dam 3A would also provide net economic benefits of $1,974,900 annually compared to $1,940,200 for Dams 1 through 4 and has a benefit-cost ratio of 2.2 compared to 2.1 for Dams 1 through 4. Dam 3A would displace only 36 families compared to 46 for Dams 1 through 4. Dam 3A would require 5,150 acres of land including 4,300 acres of cropland while Dams 1 through 4 would require 7,250 acres including 6,100 acres of cropland. Dam 3A would result in a total loss of assessed value to local taxing districts of $625,000 compared to $1,018,000 for Dams 1 through 4. Dam 3A is the least expensive. It would cost $32.5 million compared to $33.2 million for Dams 1 through 4. Dam 3A would be inferior to Dams 1 through 4 only in that it would provide fewer recreation and fish and wildlife management opportunities because it requires less land. Table C-29 provides an economic summary of Dam 3A using the current Federal interest rate of 6.125 percent.

Table C-29
Economic Summary
Dam 3A
(6.125%)

Existing Conditions	
Annual Cost	$2,511,000
Annual Benefits	3,436,000
Benefit-Cost Ratio	1.4
Base Year - 1978	
Annual Cost	$2,511,000
Annual Benefits	3,470,700
Benefit-Cost Ratio	1.4
Discounted Future Conditions	
Annual Costs	$2,511,000
Annual Benefits	3,875,000
Benefit-Cost Ratio	1.5

Recreation

440. All of the recreation plans included in the urban study are required to meet the regional recreation planning objectives. All recreation plans with the exception of those for Papillion Creek were formulated by agencies other than the Corps of Engineers. All of the plans have either a direct or indirect relationship to the water resources of the region.

PLAN DESCRIPTION

441. Three major recreation plans are included in the urban study. These are the Platte-Elkhorn Plan, the Missouri River Plan, and the Papillion Creek Plan. Table C-30 contains a brief description of the plans; a more detailed description can be found in Volume III - Annex E.

442. The Platte-Elkhorn Plan is the largest in terms of total area and is comprised of flood plain and bluff lands along the Platte River and Elkhorn River to the west and south of the Greater Omaha area. The Missouri River Plan covers a 54-mile reach of the Missouri River from Blair, Nebraska north of Omaha to Plattsmouth, Nebraska south of Omaha. The Papillion Creek Plan consists of the multi-purpose aspects of the flood control reservoirs. The last four columns in table C-30 represent the flood control alternatives for Big Papillion Creek.

Table C-30
Summary of Alternative Recreation Plans

	Platte-Elkhorn	Missouri River	Sites 10, 11, 16	Sites 1-
A. Plan Description	28,750 acres of natural areas and regional parks consisting of bluff lands and flood plains along the Platte-Elkhorn Rivers.	Extending some 54 miles along the Missouri, 21,000 acres of natural area, park lands, and scenic areas.	3 dams with 2,510 total acres, 645 water surface acres, and 1,869 land surface acres.	9 dams with total acres, 2,210 water face acres 6,599 land face acres.
B. Significant Impacts	See text.			
C. Plan Evaluation				
1. Contribution to planning objectives to reduce current and future recreation deficiencies by (%) of recreation days provided	1975 1995 2020 60 29 20	1975 1995 2020 51 25 17	1975 1995 2020 5 3 2	1975 1995 2 17 8
2. Relationship to four national accounts				
a. National economic development				
(1) Net NED benefits ($/year)	8,095,000	4,593,000	558,900	1,302,800
(2) Internal rate of return on investment (%)	22.4	19.6	29.5	24.
b. Environmental quality				
(1) Wildlife acres	19,176	14,592	741	2,697
(2) Water surface acres	300	0	650	2,200
(3) River miles	56.8	16.5	—	—
(4) Total open space (acres)	28,750	21,074	2,510	8,913
c. Social well being				
(1) Recreation visitation (recreation-days)	5,275,600	4,509,000	545,300	1,520,000
(2) Cropland removed (acres)	9,274	6,482	2,100	7,350
d. Regional development ($/year)				
(1) Beneficial impacts - value of increased output of goods and services	12,986,850	8,168,700	843,900	2,200,000

Table C-30
Summary of Alternative Recreation Plans

			Papillion Creek			
Elkhorn	Missouri River	Sites 10, 11, 16	Sites 1-9	Site 3A	Sites 1-3	Sites 1-4
acres of areas and l parks ing of ands and lains he Elkhorn t.	Extending some 54 miles along the Missouri, 21,000 acres of natural area, park lands, and scenic areas.	3 dams with 2,510 total acres, 645 water surface acres, and 1,869 land surface acres.	9 dams with 8,809 total acres, 2,210 water surface acres and 6,599 land surface acres.	1 dam with 5,150 total acres, 1,500 water surface and 3,650 land surface acres.	Composed of 3 dams with 6,321 total acres, 1,500 water surface acres and 4,596 land surface acres.	4 dams with 7,250 total acres, 1,695 water surface acres, and 5,310 land surface acres.
95 2020	1975 1995 2020	1975 1995 2020	1975 1995 2020	1975 1995 2020	1975 1995 2020	1975 1995 2020
29 20	51 25 17	5 3 2	17 8 5	13 6 4	13 6 4	15 7 5
,000	4,593,000	558,900	1,302,800	1,070,200	999,000	1,171,400
22.4	19.6	29.5	24.1	18.9	17.7	17.4
,176	14,592	741	2,697	1,000	2,150	2,350
300	0	650	2,200	1,500	1,500	1,695
56.8	16.5	—	—	—	—	—
,750	21,074	2,510	8,913	5,150	6,321	7,250
,600	4,509,000	545,300	1,520,000	1,175,000	1,154,000	1,333,000
,274	6,482	2,100	7,350	4,300	5,200	6,100
,850	8,168,700	843,900	2,200,000	1,769,000	1,706,000	2,006,000

Table C-30
(Cont'd)
Summary of Alternative Recreation Plans

	Platte-Elkhorn	Missouri River	Sites 10, 11, 16	Sites 1-
(2) Adverse impacts				
(a) Cost to Federal	1,917,102	1,336,957	33,750	106,3
(b) Cost to local 1/	2,974,840	2,238,770	273,200	860,0
(c) Cost to Federal (NRA)	3,834,202	—	—	—
(d) Cost to local (NRA)	1,057,740	—	—	—
3. Plan response to associated evaluation criteria	See text	See text	See text	See tex
D. Implementation Responsibility				
1. Funding	BOR, State, Local	BOR, C/E, State, Local	C/E, State, Local	C/E, State, Local
2. Management	State	State, Local	State, Local	State, Loc

1/ Papillion Creek costs based on non-federal investment repayment at 5.116 percent interest within 50 years.

Table C-30
(Cont'd)
ummary of Alternative Recreation Plans

lkhorn	Missouri River	Papillion Creek Sites 10, 11, 16	Papillion Creek Sites 1-9	Papillion Creek Site 3A	Papillion Creek Sites 1-3	Papillion Creek Sites 1-4
,102	1,336,957	33,750	106,300	116,900	118,600	142,300
,840	2,238,770	273,200	860,000	657,600	665,100	784,360
,202	—	—	—	—	—	—
,740	—	—	—	—	—	—
text	See text	See text	See text	See text	See text	See text
ate,	BOR, C/E, State, Local	C/E, State, Local	C/E, State, Local	C/E, State, Local	C/E, State, Local	C/E, State, Local
	State, Local	State, Local	State, Local	State, Local	State, Local	State, Local

CONTRIBUTIONS TO PLANNING OBJECTIVES

443. The recreation planning objectives are the following:

To provide enough outdoor recreation area to accommodate an additional demand of 25,350,000 activity days by 1995 and 43,704,000 activity days.

To meet 1995 activity day demands, provide an additional 5,046 acres of local parks, 36,851 acres of regional parks, and 33,900 acres of natural areas.

To meet 2020 activity day demands, provide an additional 9,377 acres of local parks, 48,104 acres of regional parks, and 41,478 acres of natural areas.

Within the above acreages, provide 26 acres for lake swimming, 8,300 acres for lake fishing, 11,952 acres of powerboating, and 6,627 acres for waterskiing by 1990.

To provide 400 miles of protected streams in the Lower Platte Basin by 2020 as indicated in the Platte Level "B" Plan.

To provide the above, using multi-purpose objectives wherever possible.

To provide for the above with the least disturbance of existing land uses.

444. Table C-30 shows each plan's contribution to the planning objectives measured in terms of percentage contribution to 1975, 1995, and 2020 recreation day deficiencies.

445. The amount of visitation at each recreation site was determined using data provided by the Bureau of Outdoor Recreation (BOR) for all areas except the Papillion Creek Plan, which was determined by the Corps of Engineers' Omaha District staff. The methodology employed by BOR to determine recreation use was to project demand for outdoor activities in terms of activity days based on a demand survey conducted by the Riverfront Development Program. The activity days were then converted to recreation days by dividing by a factor of 2.5 which assumes that a person participates in 2.5 activities during each recreation day. Thirty percent of the total recreation days were assumed to occur at regional parks, 40 percent at community parks, 10 percent at natural areas, and 20 percent at other areas. A use per each acre of regional parks, natural areas, and local parks was thus established. This use was then applied to the types of recreation experience contemplated at each site to determine each plan's contribution to the planning objectives.

446. Visitation at sites in the Papillion Creek Project were determined by a site support analysis.

447. In terms of contribution to recreation day planning objectives, the Platte-Elkhorn Plan provides the greatest contribution followed very closely by the Missouri River Plan.

448. The Platte-Elkhorn Plan followed by the Missouri River Plan contributes significantly to the objective of preserving existing natural areas for wildlife habitat and nature study. The wildlife acres indicated under the Papillion Creek alternatives would represent man-created habitat and would add to the resource base of the region.

449. The Platte-Elkhorn Plan contributes most to the objective of preserving the natural characteristics of the study area's rivers and immediate environs. The Papillion Creek alternatives are the only opportunities to significantly increase the amount of lake-type recreation. Under the Platte-Elkhorn Plan, a small number of sand pit lakes would be acquired for public use. Although no additional water surface acres are included under the Missouri River plan, a significant improvement to an existing resource is included. This improvement features the dredging of Lake Manawa to increase lake depths and hence improve recreation potential.

RELATIONSHIP TO THE FOUR ACCOUNTS

450. Each plan's contribution to National Economic Development, Environmental Quality, Social Well-Being, and Regional Development is displayed in table C-30. A more detailed evaluation of each plan is found on tables C-31 through C-33.

451. Each recreation plan contains numerous sites that were grouped together for evaluation purposes. Details on individual sites under each grouping can be found in Volume III - Annex E.

NATIONAL ECONOMIC DEVELOPMENT

452. Beneficial impacts are the value of the recreation provided. The value is determined by assigning a dollar benefit to the annual expected visitation.

453. For areas other than the Papillion Creek Project, a value of \$2.50 per recreation day was assigned by BOR to regional parks, \$2.25 per recreation day to natural areas, and \$1.50 per recreation

Table C-31
System of Accounts - Platte-Elkhorn Recreation Plans

	Footnotes 1/	PE-1
I. National Economic Development		
A. Beneficial Impacts ($/year)		
1. Value of increased output of goods and services		
a. Recreation	3, 5, 7, 9	2,499,400
B. Adverse Impacts ($/year)		
1. Project costs		
a. I&A	1, 5, 7, 9	948,390
b. O&M	2, 5, 7, 9	212,480
c. Total NED costs		1,160,870
C. Net NED Benefits ($/year)		1,338,530
D. Internal Rate of Return on Investment (%)		17.4
II. Environmental Quality		
A. Wildlife Acres	2, 5, 7, 9	5,771
B. Water Surface Acres	2, 6, 7, 9	0
C. River Miles	2, 6, 7, 9	9.5
D. Total Open Space (Acres)	2, 5, 7, 9	9,200
III. Social Well-Being		
A. Beneficial Impacts		
1. Recreation visitation (recreation-days)	2, 5, 7, 9	1,062,400
B. Adverse Impacts		
1. Farmland removed (acres)	1, 5, 7, 9	3,429
IV. Regional Development		
A. Beneficial Impacts ($/year)		
1. Value of increased output of goods and services	2, 5, 7, 9	2,499,400
B. Adverse Impacts ($/year)		
1. Cost to Federal (NRA)	2, 5, 7, 9	948,390
2. Cost to local (NRA)	2, 5, 7, 9	212,480
3. Cost to Federal	1, 5, 7, 9	474,195

1/ Footnotes indexed at the end of table C-33.

Table C-31
tem of Accounts - Platte-Elkhorn Recreation Plans

Footnotes 1/	PE-1	PE-2	PE-3	PE-4
3, 5, 7, 9	2,499,400	5,413,950	849,750	4,223,750
1, 5, 7, 9	948,390	1,496,350	220,917	1,168,545
2, 5, 7, 9	212,480	437,640	69,720	337,900
	1,160,870	1,933,990	290,637	1,506,445
	1,338,530	3,479,960	559,113	2,717,305
	17.4	23.9	25.4	23.9
2, 5, 7, 9	5,771	6,201	2,126	5,078
2, 6, 7, 9	0	300	0	0
2, 6, 7, 9	9.5	18.0	13.0	16.3
2, 5, 7, 9	9,200	9,600	2,200	7,750
2, 5, 7, 9	1,062,400	2,188,200	348,600	1,676,400
1, 5, 7, 9	3,429	3,099	74	2,672
2, 5, 7, 9	2,499,400	5,413,950	879,750	4,223,750
2, 5, 7, 9	948,390	1,496,350	220,917	1,168,545
2, 5, 7, 9	212,480	437,640	69,720	337,900
1, 5, 7, 9	474,195	748,175	110,459	584,273

Table C-31
(Cont'd)
System of Accounts - Platte-Elkhorn Recreation Plans

	Footnotes 1/	PE-1
4. Cost to local	2, 5, 7, 9	686,675
C. Regional Employment **($/year)**		127,488
1. Jobs created for operation and maintenance	2, 5, 7, 9	14
D. County Assessed Value Lost ($)		
1. Douglas County	1, 5, 7, 9	417,000
2. Sarpy County	1, 5, 7, 9	142,000
3. Washington County	1, 5, 7, 9	206,000

1/ Footnotes indexed at the end of table C-33.

Table C-31
(Cont'd)
m of Accounts - Platte-Elkhorn Recreation Plans

Footnotes 1/	PE-1	PE-2	PE-3	PE-4
2, 5, 7, 9	686,675	1,185,815	180,178	922,172
	127,488	262,584	41,832	202,740
2, 5, 7, 9	14	28	5	22
1, 5, 7, 9	417,000	0	144,000	329,000
1, 5, 7, 9	142,000	871,000	0	444,000
1, 5, 7, 9	206,000	0	0	0

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Table C-32
System of Accounts - Missouri River Recreation Plans

	Footnotes 1/	MR-1	MR-2	MR-3
I. National Economic Development				
A. Beneficial Impacts ($/year)				
1. Value of increased output of goods and services				
a. Recreation	3, 5, 7, 9	381,500	1,574,895	3,376,087
B. Adverse Impacts ($/year)				
1. Project costs				
a. I&A	1, 5, 7, 9	104,670	864,000	886,284
b. O&M	2, 5, 7, 9	30,520	259,115	277,134
c. Total NED costs		135,190	1,123,115	1,163,418
C. Net NED Benefits ($/year)		246,310	451,780	2,212,669
D. Internal Rate of Return on Investment (%)		24.1	11.0	25.2
II. Environmental Quality				
A. Wildlife Acres	2, 5, 7, 9	245	5,989	5,124
B. River Miles	2, 6, 7, 9	2.0	5.2	0
C. Total Open Space (acres)	2, 5, 7, 9	700	7,500	8,790
III. Social Well-Being				
A. Beneficial Impacts				
1. Recreation visitation (recreation-days)	2, 5, 7, 9	152,600	1,295,579	1,385,670
B. Adverse Impacts				
1. Farmland removed (acres)	1, 5, 7, 9	455	1,511	3,666
IV. Regional Development				
A. Beneficial Impacts ($/year)				
1. Value of increased output of goods and services	2, 5, 7, 9	381,500	1,574,895	3,376,087
B. Adverse Impacts ($/year)				
1. Cost to Federal	1, 5, 7, 9	52,335	432,000	443,142
2. Cost to local	2, 5, 7, 9	82,855	691,115	720,276

1/ Footnotes indexed at the end of table C-33.

Table C-32
n of Accounts - Missouri River Recreation Plans

1/	MR-1	MR-2	MR-3	MR-4	MR-5	MR-6	MR-7
9	381,500	1,574,895	3,376,087	58,725	2,483,190	130,800	163,500
9	104,670	864,000	886,284	31,320	687,960	32,000	67,680
9	30,520	259,115	277,134	13,080	298,400	10,464	13,100
	135,190	1,123,115	1,163,418	44,400	986,360	42,464	80,780
	246,310	451,780	2,212,669	14,325	1,496,830	88,336	82,720
	24.1	11.0	25.2	10.5	22.9	27.1	16.0
9	245	5,989	5,124	60	2,934	240	0
9	2.0	5.2	0	0.3	8.5	0.5	0
9	700	7,500	8,790	300	3,244	240	300
9	152,600	1,295,579	1,385,670	65,400	1,492,000	52,320	65,400
9	455	1,511	3,666	240	310	0	300
9	381,500	1,574,895	3,376,087	58,725	2,483,190	130,800	163,500
9	52,335	432,000	443,142	15,660	343,980	16,000	33,840
9	82,855	691,115	720,276	28,740	642,380	26,464	46,940

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Table C-32
(Cont'd)
System of Accounts - Missouri River Recreation Plans

	Footnotes 1/	MR-1	MR-2	MR-3
C. Regional Employment ($/year)		18,312	155,469	166,280
1. Jobs created for operation and maintenance	2, 5, 7, 9	2	17	18
D. County Assessed Value Lost ($)				
1. Douglas County	1, 5, 7, 9	0	0	0
2. Sarpy County	1, 5, 7, 9	0	0	0
3. Washington County	1, 5, 7, 9	79,000	320,000	0
4. Pottawattamie County	1, 5, 7, 9	0	0	1,053,000

1/ Footnotes indexed at the end of table C-33.

Table C-32
(Cont'd)
of Accounts - Missouri River Recreation Plans

/	MR-1	MR-2	MR-3	MR-4	MR-5	MR-6	MR-7
	18,312	155,469	166,280	7,848	179,040	6,278	7,860
	2	17	18	1	20	1	1
	0	0	0	0	83,000	0	0
	0	0	0	0	139,000	5,000	0
	79,000	320,000	0	0	0	0	0
	0	0	1,053,000	26,000	150,000	0	0

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Table C-33
System of Accounts - Papillion Creek Recreation Plans

	Footnotes 1/	Sites 1-9	Site 10	Sites 11, 16
I. National Economic Development				
A. Beneficial Impacts ($/year)				
1. Value of increased output of goods and services				
a. Recreation 2/	3, 5, 7, 9	2,200,000	93,300	750,600
B. Adverse Impacts ($/year)				
1. Project costs				
a. I&A	1, 5, 7, 9	212,600	10,500	56,900
b. O&M	2, 5, 7, 9	684,600	26,100	191,500
c. Total NED costs		897,200	36,600	248,400
C. Net NED Benefits ($/year)		1,302,800	56,700	502,200
D. Internal Rate of Return on Investment (%)		24.1	22	31.0
II. Environmental Quality				
A. Wildlife Acres	2, 5, 7, 9	2,697	145	596
B. Water Surface Acres	2, 5, 7, 9	2,200	125	525
C. Total Open Space Acres	2, 5, 7, 9	8,913	510	2,000
III. Social Well-Being				
A. Beneficial Impacts				
1. Recreation visitation (recreation-days)	2, 5, 7, 9	1,520,000	70,000	475,300
B. Adverse Impacts				
1. Farmland removed (acres)	1, 5, 7, 9	7,350	420	1,680
IV. Regional Development				
A. Beneficial Impacts ($/year)				
1. Value of increased output of goods and services	2, 5, 7, 9	2,200,000	93,300	750,600

1/ Footnotes indexed at the end of this table.

Table C-33
tem of Accounts - Papillion Creek Recreation Plans

tnotes 1/	Sites 1-9	Site 10	Sites 11, 16	Site 3A	Sites 1-3	Sites 1-4
5, 7, 9	2,200,000	93,300	750,600	1,769,000	1,706,000	2,006,000
5, 7, 9	212,600	10,500	56,900	233,800	237,200	284,600
5, 7, 9	684,600	26,100	191,500	465,000	469,800	550,000
	897,200	36,600	248,400	698,800	707,000	834,600
	1,302,800	56,700	502,200	1,070,200	999,000	1,171,400
	24.1	22	31.0	18.9	17.7	17.5
, 7, 9	2,697	145	596	1,000	2,150	2,350
, 7, 9	2,200	125	525	1,500	1,500	1,695
, 7, 9	8,913	510	2,000	5,150	6,321	7,250
, 7, 9	1,520,000	70,000	475,300	1,175,000	1,154,000	1,333,000
, 7, 9	7,350	420	1,680	4,300	5,200	6,100
, 7, 9	2,200,000	93,300	750,600	1,769,000	1,706,000	2,006,000

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Table C-33
(Cont'd)
System of Accounts - Papillion Creek Recreation Plans

	Footnotes 1/	Sites 1-9	Site 10	Sites 11, 16
B. Adverse Impacts ($/year)				
1. Cost to Federal	1, 5, 7, 9	106,300	5,300	28,450
2. Cost to local 3/	2, 5, 7, 9	860,000	34,800	238,400
C. Regional Employment				
1. Jobs created for operation and maintenance	2, 5, 7, 9	9	4	16
D. County Assessed Value Lost ($/year)				
1. Douglas County	1, 5, 7, 9	210,000	64,300	262,500
2. Washington County	1, 5, 7, 9	966,000	0	0

1/ Footnotes indexed at the end of this table.

2/ Includes fish and wildlife and water quality.

3/ Based on non-Federal investment repayment at 5.116 percent interest within 50 years.

Index of Footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty

4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

Table C-33
(Cont'd)
of Accounts - Papillion Creek Recreation Plans

tes 1/	Sites 1-9	Site 10	Sites 11, 16	Site 3A	Sites 1-3	Sites 1-4
7, 9	106,300	5,300	28,450	116,900	118,600	142,300
7, 9	860,000	34,800	238,400	657,600	665,100	784,360
7, 9	9	4	16	4	3	4
7, 9	210,000	64,300	262,500	260,000	0	0
7, 9	966,000	0	0	365,000	766,000	966,000

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recreation day to community parks. Recreation day values of $1.20 to $1.50 were used for the Papillion Creek Project reflecting use as community parks. The Papillion Creek alternatives include only the recreation, fish and wildlife, and water quality benefits of the flood control reservoirs.

454. The adverse impacts of the alternatives are the costs. These costs are displayed as investment and amortization (I&A), and operation and maintenance (O&M). Acquisition and development costs for the Papillion Creek alternatives include only the recreation costs and were taken from the current reevaluation with methodologies delineated in the Flood Control Plan Formulation Annex. Acquisition and development costs for the Riverfront Development portion of the Missouri River Plan were obtained from the Metropolitan Area Planning Agency. Acquisition costs for other areas were determined by a detailed site-specific land-use capability analysis. Lands suitable either for housing or agriculture were valued at $1,500 per acre. Other lands were valued at $450 per acre. Detailed soil classification maps prepared by the Soil Conservation Service were used to determine the land capability of each site. The SCS classifications relate to potential use rather than existing use. Potential use is a more appropriate measure of land value. Costs of $1,000 per acre for areas designated for general recreation use and $500 per acre for natural areas were added to acquisition cost for development purposes. These development costs were recommended by BOR based on National averages. Acquisition and development costs for all plans except Papillion Creek were amortized over 100 years at 7 percent interest. Papillion Creek recreation costs were amortized over 100 years at 3 1/4 percent interest which is the rate applied to the authorized project.

455. Operation and maintenance costs for all areas except the Papillion Creek Project were valued at \$0.20 per recreation day which is the value used for the Platte River Basin Level "B" Study. O&M costs for the Papillion Creek Project were obtained from the current reevaluation and are based on specific facilities.

456. Two evaluations of the economics of the alternatives are displayed as the net annual NED benefits and the internal rate of return on investment.

457. Net annual NED benefits are total benefits minus total costs. The internal rate of return on investment gives the benefits per dollar spent. Thus from a purely economic point of view, the larger the internal rate of return on investment, the larger is the benefit per dollar spent. The use of internal rate of return on investment removes the bias created by the two different interest rates.

458. All recreation plans have comparable high internal rate of returns on investment. The Platte-Elkhorn Plan produces the largest net NED benefits and is labeled as the NED plan. Because all the recreation plans are needed to fulfill the planning objectives, they all could be considered as NED plans.

ENVIRONMENTAL QUALITY

459. Beneficial effects on environmental quality (EQ) include the preservation or creation of wildlife areas, river reaches, water surface areas, and open space.

460. Wildlife areas are those lands which will provide for wildlife habitat. Wildlife acres represent total project acres minus those acres with farming potential. In the Papillion basin, this designation is for project lands specifically earmarked for wildlife management.

461. River reaches are given in miles of streambank reserved for public use or protected from development. Water surface areas represent a benefit to aquatic life in the area. Only lake water surface acres have been included. Total open space is the total area that would be permanently preserved from development.

462. The EQ plan is selected on the basis of maximizing open space and wildlife habitat and the preservation of natural environments.

463. In terms of environmental quality, the Platte-Elkhorn Plan is preferable to the other two plans. The natural characteristics of the Platte-Elkhorn Rivers and the critical need for preservation of the streamflows and adjacent lands are well documented in the Nebraska State Comprehensive Outdoor Recreation Plan and the Platte Level "B" Studies. Almost 57 river miles would be protected from encroachment under the Platte-Elkhorn Plan.

464. The Missouri River Plan ranks a close second to the Platte-Elkhorn Plan. While the Missouri is a controlled river and is used for commerce, it does contain good esthetic qualities. Lands adjacent to the Missouri River offer excellent recreational and wildlife qualities. The bluffs on the east side of the river are world-famous examples of loessial formations.

465. The Papillion Creek Plan's environmental attributes arise primarily from the lakes that will be created and the creation of open space in suburban environment. The lakes will partially fulfill a critical need for lake-oriented recreation in the study area. The lakes will, however, be subject to eutrophication problems.

SOCIAL WELL-BEING

466. The social well-being table presents the following impacts:

Beneficial: Educational, cultural, and recreational opportunities.

Adverse: Reduction in agricultural production.

467. Annual recreation days provided are the criteria used in defining educational, cultural, and recreational opportunities. The methodology for determining the recreation days under each plan was discussed earlier. In terms of non-mobile social groups, the Missouri River Plan is the most available. Both the Platte-Elkhorn and Papillion Projects are beyond the reach of these groups because of the lack of public transportation. On the other hand, the Missouri River Plan includes the N. P. Dodge Park, Airport Bend Park, Gifford Environmental Center, Lake Manawa, and numerous smaller parks. These parks are within the area covered by the local public transportation system and are located close to lower income groups.

468. The adverse impact is the amount of land taken out of agricultural production. Lands indicated for the Papillion Creek alternatives include those required for the flood control project.

Since farmland is taken out of production, there would be a displacement of families. This displacement was quantified and discussed previously under Flood Control. Displacement of families for the other plans was not quantified. Implementation of open space and recreation in these areas would not necessarily require family displacement.

469. The amount of farmland in each recreation plan was determined by specific site analysis using SCS soil surveys, aerial photography, and U.S.G.S. maps.

470. All plans as currently formulated would incorporate some food-producing lands. The Papillion Creek Project would require a greater amount of agricultural land in comparison to the recreation provided than would the Platte-Elkhorn or Missouri River Plans. All agricultural lands required for the recreation plans could be returned to production if required to respond to future food shortages. Lands in the Papillion Creek Plan would be more difficult to return to production than would lands under the other two plans.

REGIONAL DEVELOPMENT

471. Implementation of any of the recreation plans would create changes in the region's income, employment, population distribution, and economic base which in turn would influence the course and direction of the development of the region. Beneficial impacts include redistribution of income from the Nation to the region, measured in the value of the recreation provided, increased regional employment, and improvement of the economic base of a few small communities. Adverse impacts consist of the local costs of the recreation plans and the decrease of the tax base.

472. Income redistribution would result from the incidence of the benefits and costs of each alternative between the Nation and the region. Recreation benefits would accrue primarily to the region. The value of the use of employed labor also would accrue to the region. The costs of each alternative are divided between the region and the Nation in accordance with Federal cost-sharing policies. For the Platte-Elkhorn Plan, two alternative cost-sharing arrangements are indicated. The first arrangement assumes the standard 50 percent Federal, 50 percent State/local cost share. The second arrangement assumes National Recreation Area designation with all costs being provided by the Federal Government. Recreation costs for the Papillion Creek Project are shared 50/50 between the Federal Government and a local sponsor. Operation and maintenance costs on all plans are assumed to be a local responsibility; however, under a National Recreation Area, the Federal Government may provide all or part of the O&M costs. All of the recreation plans provide a redistribution of income from the Nation to the region.

473. Regional employment includes the jobs created for operation and maintenance at all recreation sites. In Nebraska and Iowa, this amounts to about 60 percent of total operation, maintenance, and replacement costs.

PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA

474. Important associated evaluation criteria are each plan's acceptability and certainty.

475. Based on the urban study public involvement efforts, the public is almost equally divided in its preference of the plans. The Platte-Elkhorn Plan appears to be the most favored among environmentally-oriented citizens. The Missouri River Plan is supported by proponents of the Missouri Riverfront Development Program. The Papillion Creek Plan is favored by those citizens desirous of more lake-type recreation near the urban area.

476. The main opposition to the recreation plans comes from current landowners. This opposition was most vocal on the Papillion Creek Plan.

477. The Platte-Elkhorn and Missouri River Plans offer more flexibility to compromise opposition than does the Papillion Creek Plan. Recreation facilities for the Papillion Creek Plan must be centered around the flood control reservoirs. The other two plans can be implemented in an incremental and partial fashion based on the desires of existing landowners. More options of preservation or acquisition are available for the Platte-Elkhorn and Missouri River Plans. In addition to outright purchase, other measures such as easements, grants, tax incentives, and donations can also be used to place the lands under the Missouri River and Platte-Elkhorn Plans in public domain. These options could ease some of the opposition.

478. In terms of certainty, the Papillion Creek Plan and the Missouri River Plan rank ahead of the Platte-Elkhorn Plan. Recreation development at Dams 11 and 16 is assured. Dam 10 is justified on the basis of flood control and would offer at lease minimal recreational opportunity. The Omaha District Engineer

has recommended the Dam 3A alternative for flood control on the Big Papillion Creek. This dam, even without the proposed additional recreation lands, would contribute significantly to the recreation planning objectives.

479. Portions of the Missouri River Plan benefit from the backing of groups organized under the Missouri Riverfront Development Program. This support has brought portions of the Missouri River Plan, such as the Lake Manawa expansion, close to reality. Portions of the Missouri River Plan can also be aided by the Corps of Engineers through the authorized Missouri River Channelization and Stabilization Project. This project allows Corps of Engineers' cost sharing on recreation facilities physicially adjacent to the Missouri River.

480. There is a possibility that the Platte-Elkhorn Plan could qualify for designation as a National Recreation Area. This concept must be further investigated through a Congressionally-authorized study. Without such designation, only limited portions of the Platte-Elkhorn Plan could be implemented because of financial constraints.